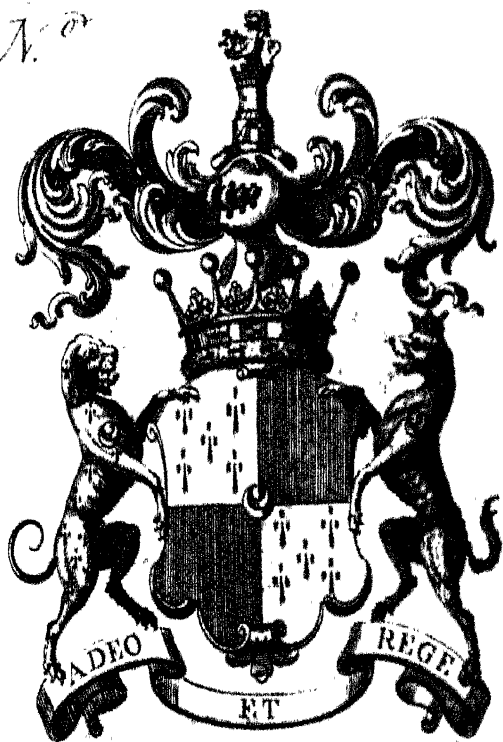


N. 10



Philip Earl. Sandwich.



AGRICULTURAL RESEARCH INSTITUTE
PUSA

PHILOSOPHICAL TRANSACTIONS.

GIVING SOME

ACCOUNT

OF THE

Present Undertakings, Studies, *and* Labours,

OF THE

INGENIOUS,

IN MANY

Considerable Parts of the WORLD.

VOL. XLI. Part I. For the Years 1739, 1740.

L O N D O N :

Printed for T. WOODWARD, and C. DAVIS, over-
against *Gray's Inn-Gate* in *Holbourn*; PRINTERS
to the ROYAL SOCIETY. M.DCC.XLIV.

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VOL. XLI. Part II. For the Years 1740, 1741.

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ERRATA.

Nº 456. in the Contents, Art. V. for ——— read *John Machin, Esq;*
Sec. R. S.

Nº 457. p. 389. l. 11. for *ra* read *Art.*

Nº 458. p. 492. l. 29. for *Emmory* read *Emelie.*

Nº 459. p. 630. Art. XV. *Mercurius a Venere sublatus.* Vide supra
Nº 450. p. 394.

To the Bookbinder.

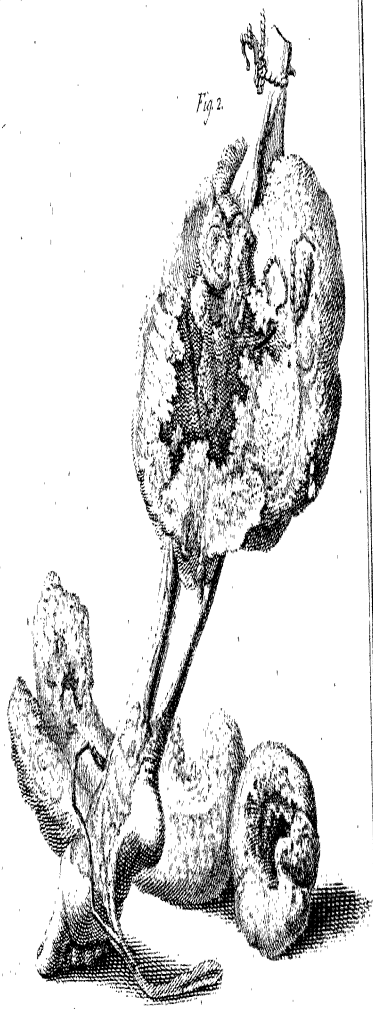
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Fig. 1



Fig. 2



A Scale of Inches



T. Ross pinxit

T. Mynde deli et sculpit

Fig. 1.

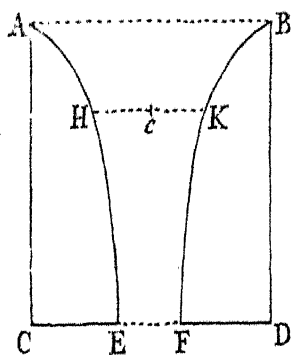


Fig. 2.

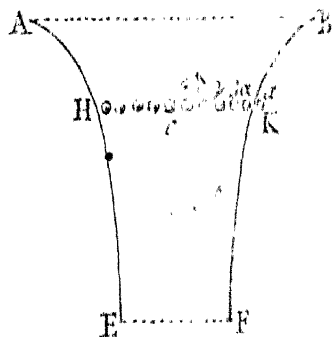
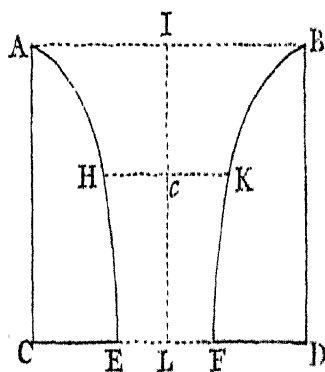


Fig. 3.



PHILOSOPHICAL TRANSACTIONS.

For the Months of *January, February, and*
March, 1739.

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- II. *De Mensura & Motu Aquarum fluentium. Tentamen Primum. Quò agitur de aqua effluente ex vase semper pleno per foramen rotundum, & de resistentia ejusdem ex defectu lubricitatis oriunda. Auctore Jacobo Jurin, Soc. Reg. & Coll. Medic. Londinens. Sodale.*
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IV. *An Account of a very extraordinary Tumour in the Knee of a Person, whose Leg was taken off by Mr. Jer. Peirce, Surgeon at Bath; communicated in a Letter to Dr. Mead, Physician to His MAJESTY, and Fellow of the College of Physicians, and of the Royal Society, London.*

V. *An Experiment concerning the Spirit of Coals, being part of a Letter to the Hon. Rob. Boyle, Esq; from the late Rev. John Clayton, D. D. communicated by the Right Rev. Father in God Robert Lord Bishop of Corke to the Right Hon. John Earl of Egmont, F. R. S.*

VI. *An Experiment concerning the nitrous Particles in the Air; by the same Hand.*

VII. *Extract of a Letter from John Ratty, M. D. to Dr. Mortimer, Sec. R. S. concerning the Poison of Laurel-Water.*

*BOOKS lately printed for T. WOODWARD, at
the Half-Moon, between the Temple Gates, and
C. DAVIS, in Pater-noster-row; Printers to the
ROYAL SOCIETY.*

I. **T**HE Elements of the Art of Assaying Metals. In Two Parts. The first containing the Theory, the second the Practice, of the said Art. The Whole deduced from the true Properties and Nature of Fossils; confirm'd by the most accurate and unquestionable Experiments, explain'd in the natural Order, and with the utmost Clearness. By *John Cranmer, M. D.* Translated from the *Latin*, illustrated with Copper Plates. To which are added, Several Notes and Observations, not in the Original, particularly useful to the *English* Reader. With an Appendix, containing a List of the chief Authors that have been published in *English*, upon Minerals and Metals.

II. A Treatise of Diseases in General; wherein the true Causes, Natures, and Essences, of all the principal Diseases incident to the Human Body, are mechanically accounted for and explained, and their respective Intentions of Cure assign'd upon the same Principles. To which is subjoined, A System of Practice, applied to each Disease, and constituted upon the same most legitimate and solid Principles of Mechanical Reasoning. The Prescriptions, in *English*, all render'd familiar to every Capacity; and digested (for Method's sake) into seven Books. With an Appendix, containing a Philosophical Essay on the Nature, Properties, Action, Use and Abuse of Quicksilver. Comprehending likewise a cursory View of the wonderful Virtues and Properties of Antimony and Steel. In Two Volumes. By *Charles Perry, M. D.*

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Im:

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Improvement: An Account of the Rivers of *England*, &c. and how far they may be made Navigable; of Weights and Measures of Woods, Cordage, and Metals; of Building and Stowage, the Vegetation of Plants, &c. with many other useful Particulars, communicated by several eminent Members of the Royal Society, to the Collector *John Houghton*, F.R.S. Now revised, corrected, and published, with a Preface, and useful Indexes, by *Richard Bradley*, F.R.S. and Professor of Botany in the University of *Cambridge*. In 4 Vols. 8vo.

V. Philosophical Experiments: Containing useful and necessary Instructions for such as undertake long Voyages at Sea. Shewing how Sea-Water may be made fresh and wholesome; and how fresh Water may be preserved sweet. How Biscuit, Corn, &c. may be secured from the Wheevil, Meggots, and other Insects. And Flesh preserved in hot Climates, by salting Animals whole. To which is added, An Account of several Experiments and Observations on Chalybeate or Steel-waters; with some Attempts to convey them to distant Places, preserving their Virtue to a greater Degree than has hitherto been done. Likewise Proposals for clearing away Mud, &c. out of Rivers, Harbours, and Reservoirs. Which were read before the *Royal Society* at several of their Meetings, by *Stephen Hales*, D.D. F.R.S. Rector of *Faringdon* in *Hampshire*, and Minister of *Teddington*, *Middlesex*.

VI. Vegetable Essays; containing Vegetable Statics: Or, An Account of some Statical Experiments on the Sap in Vegetables. Being an Essay towards a Natural History of Vegetation, of Use to those who are curious in the Culture and Improvement of Gardening, &c.

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VIII. Dr. *Lobb's* Treatise of the Small-pox, recommended by Dr. *Boerhaave*.

IX. A Treatise of the Venereal Disease, in Six Books; containing an Account of the Original, Propagation, and Contagion of this Distemper in General: As also of the Nature, Cause and Cure of all Venereal Disorders in Particular, whether Local or Universal. Together with an Abridgment of the several Discourses which have been written upon this Subject, from the first Appearance of the Venereal Disease in *Europe*, to this Time, with critical Remarks upon them. Written originally in *Latin* by *John Astruc*, Physician to his present Majesty the King of *France*, *Augustus II.* late King of *Poland*, and to his Highness the present Duke of *Orleans*, and now translated into *English* by *William Barrowby*, M.B. in Two Vol. 8vo.

TO the HONOURABLE
Sir HANS SLOANE, *Bar^t. M. D.*

Late
PRESIDENT *of the* ROYAL SOCIETY, and
ROYAL COLLEGE *of* Physicians, LONDON;
First Physician *to His* MAJESTY;
Member *of the* Imperial Academy *of* Sciences
at ST. PETERSBURGH,
The ROYAL ACADEMIES *of* SCIENCES
at PARIS, MADRID, and BERLIN,

And
Fellow *of the* ROYAL COLLEGE *of* Physicians
at EDINBURGH, &c.

SIR,

I CANNOT sufficiently extol that eminent
Zeal you have shewn on all Occasions
for the Promotion of *Natural Knowledge*,
the present Perfection of which is greatly in-
debted to your Labours and Patronage. The

A

noble

DEDICATION.

noble and immense Collection you have made of the most rare and valuable Curiosities, and a Library the most complete in the Universe, in all the Branches of Natural History and Physic, have not only been a Treasure to yourself, but a common Benefit to Mankind; your generous Disposition having constantly led you to communicate their Use to whoever at home or abroad was desirous to improve himself, or to inform the rest of the World.

As your great Knowledge and Skill in your own Profession, brought you into the highest and most extensive Practice for a long and uninterrupted Course of Years, so your Merit and Reputation could not fail of setting you at the Head of those two learned Bodies, you had so much loved and served, the *Royal College of Physicians*, and the *Royal Society of LONDON*, over which you presided with so much Dignity and Honour.

YOUR Favours to the *Royal Society* in particular, have been too many to be here mentioned;

D E D I C A T I O N.

tioned; and your Regard for that Body hath ever been conspicuous, by your constant and diligent Application to their Affairs, in the midst of the greatest and most necessary Avocations; yet such has been your Modesty, that you have lately, to our general Regret, resigned the Office of President, which you could not be induced to hold any longer, when you began to apprehend the Infirmities of a venerable Age might oblige you to be less constant in your Attendance on the Duties of it.

GIVE me Leave, Sir, in this Place, also to record my own Thankfulness to you, by whose Recommendation I at first obtained the Honour of being chosen one of the Secretaries of the *Royal Society*, which hath been so many Years continued to me; an Employ, I hope, I have discharged, at least, with Diligence and Fidelity, and shall always endeavour so to do: I beg of you to take under your Protection those Volumes of Papers sent to the *Royal Society*, that have been published under my Inspection, and particu-

DEDICATION.

larly to Patronize this *Forty-first* Volume of the *Philosophical Transactions*, which ends with the last Year of your Presidentship. I remain,

Honoured S I R,

Your much devoted

Dartmouth-street,
WESTMINSTER,

and obliged

Dec. 31. 1741.

Humble Servant,

CROMWELL MORTIMER, M.D.

Secretary to the ROYAL SOCIETY, and
Fellow of the ROYAL COLLEGE of
PHYSICIANS LONDON.

1. *A Catalogue of the FIFTY PLANTS from Chelsea Garden, presented to the ROYAL SOCIETY by the Company of Apothecaries, for the Year 1737. pursuant to the Direction of Sir Hans Sloane, Bart. Med. Reg. & Soc. Reg. Præf. by Isaac Rand, Apothecary, F. R. S. Hort. Chel. Præf. ac Prælec. Botan.*

751. **A** CETOSA Ægyptia; roseo feminis involucro; folio lacero; *Lippi. D. Sharw Phyt. Afr. Spec. No. 5.*

752. *Adiantum nigrum*; radice prælonga, arbores annosas perreptante. *Gris. Virid. Lusitan.*

Filicula Lusitanica; *Polypodii radice.* T. *Inst.*

541.

753. *Admirabilis Peruviana*; flore rubro. *Clus. rar. Plant. Hist. Lib. V. p. 89. Sloan. Cat. Jam. 91.*

754. *Androsæmum maximum* frutescens. C. B. 280.

755. *Aralia Canadensis.* T. *Inst.* 300.

Panaces καρπιμον sive racemosa, Canadensis. Cornut. 74.

756. *Astrantia major*; corona floris candida. T. *Inst.* 314.

757. *Astrantia major*; corona floris purpurascens. T. *Inst.* 314.

758. *Betonica Orientalis*; folio angustissimo, & longissimo; spica florum crassiori. T. *Cor.* 13.

759. *Bidens Americana triphylla*; foliis angustis, acutis.

Chrysanthemum Virginianum, folio acutiore lævi trifoliato; seu *Anagyridis* folio. H. Ox. III. p. 21.

760. *Campanula pentagonia*, perfoliata. Moris. H. Ox. II. 457.

761. *Cassine* vera perquam similis, *Arbuscula Phillyreæ* foliis antagonistiis. Ex Provincia Caroliniensi. Pluk. Mantiss. p. 40. Phytogr. Tab. 381. Fig. 3.

762. *Cepa fissilis*. Matthiol. 555.

763. *Cepa Ascalonia*. Matthiol. 556.

764. *Chenopodium Ambrosioides Mexicanum* fruticosum.

765. *Christophoriana Americana* procerior & longius spicata. Dillen. H. Elt. Tab. 67.

766. *Commelina angustifolia procumbens*.

767. *Dalea*. Dni. Millar inventoris.

768. *Dentaria bulbifera*. Lob. Icon. 687.

769. *Digitalis minima*, *Gratiola dicta*. H. Ox. Part. II. 479.

Gratiola Centauroides. C. B. 279.

770. *Elichrysum*; angustissimo folio. T. Inst. 452.

Stæchas citrina tenuifolia altera, sive Italica. J. B. III. 155.

771. *Epimedium*. C. B. 323. Dod. 599.

772. *Eruca sylvestris*. Ger.

Eruca sylvestris tenuifolia perennis; flore luteo. J. B. II. 861.

773. *Eruca*; *Bellidis* folio. Mor. H. Ox. P. II. 231.

774. *Eupatorium cannabinum*. C. B. 320.

Eupatorium Avicennæ Officin.

775. Eu-

775. Eupatorium; folio oblongo rugoso; caule purpurascente. *T. Inst.* 456.

776. Fagopyrum erectum; feminibus ad angulos dentatis, spicatum nascentibus. *Ex Russia.*

777. Ficus Orientalis; foliis in lacinias angustas profunde incis. *s.*

The large white Turkey Fig.

778. Fumaria officinarum & Dioscoridis. *C. B.* 143.

779. Fumaria bulbosa; radice cava, major. *C. B.* 143.

780. Fumaria lutea. *C. B.* 143.

781. Fumaria semper virens & florens; flore albo. *Boerb. Ind.* I. 130.

782. Galeopsis patula segetum; flore purpurascente. *T. Inst.* 185.

Sideritis arvensis rubra. Park.

783. Hernandia; amplo Hederæ folio, umbilicato. *Plum. Nov. Gen.* 6.

Nux vesicaria oleosa, foliis umbilicatis, ex Insula Barbadosi. Pluk. Phyt. 208. Fig. 1.

784. Hypericum Androsæmum dictum. *J. B. III.* 382.

Androsæmum alterum hirsutum. Colum. Ec. 75.

785. Lycopersicon Galeni. *Ang.* 217.

786. Pctiveria, Solani foliis; loculis spinosis. *Plum. Nov. Gen.* 50.

Verbena aut Scorodoniæ affinis anomala, flore albido; calyce aspero; Allii odore. Sloan. Cat. Jam.

64. Guinea Hen-weed. Hist. I. 172.

787. Pyrethrum Officinarum.

Pyrethrum flore Bellidis. *C. B.* 148.

*Chamæmelum specioso flore ; radice longa fer-
vida.* D. Shaw. Phyt. Afric. Spec. No. 138.

788. *Pyrethrum frutescens Canariense.*

*Leucanthemum Canariense ; foliis Chrysan-
themii ; Pyrethri sapore.* T. Inst. 666.

789. *Rapuntium Americanum, flore dilute cœ-
ruleo.* Ac. Reg. Par.

790. *Rapuntium Virginianum ; foliis oblongis ;
floribus parvis cœruleis, spica longissima laxa.*

791. *Refeda alba.* J. B. III. 467.

792. *Refeda crispa Gallica.* Bocc. Rar. 76.

793. *Solanum fruticosum bacciferum.* C. B. 166.

794. *Thlaspidium fruticosum ; Leucoii folio, sem-
per florens.* T. Inst. 214.

*Thlaspi fruticosum Persicum ; foliis Keiri, flore,
odorato.* Zanon. 196.

795. *Trichomanes sive Polytrichum Officinarum.*
C. B. 356.

796. *Turritis vulgaris ramosa.* T. Inst. 224.

Pilosella siliquata Thalii. Tab. vii.

797. *Turritis Leucoii folio.* T. Inst. 224.

798. *Turritis Leucoii folio ; floribus amplioribus.*

799. *Ulmaria.* Clus. Hist. CXCVIII.

Barba Capræ floribus compactis. C. B. 164.

800. *Ulmaria ; floribus in longas spicas congestis.*
Boerb. Ind. Alt. 295.

Barba Capræ floribus oblongis. C. B. 163.

II. De Mensura & Motu Aquarum fluentium.

TENTAMEN PRIMUM.

Quo agitur de aqua effluente ex vase semper pleno per foramen rotundum, & de resistantia ejusdem ex defectu lubricitatis oriunda. Auctore Jacobo Jurin, Soc. Reg. & Colleg. Medic. Londinens. Sodale.

Aquarum fluentium *Mensuram* veteres nullam habuerunt, nisi incertam illam & fallacem, quæ, nulla velocitatis habita ratione, sola rivi sectione perpendiculari nitebatur. Ad veram aditum primus aperuit, centum circiter abhinc annis, *Benedictus Castellus, Italus, Galileo* familiaris. Is quum comperisset copiam aquæ per datam rivi sectionem transfluentis, datam non esse, quod veteres crediderant, sed proportionalem celeritati qua fertur aqua per datam sectionem, nobili hoc invento novæ & utilissimæ fundamenta scientiæ jecit, *Hydraulicæ*. Hoc itaque auctore philosophi certatim in eam disciplinam excolendam incubuerunt, ut nemo pene fuerit a *Castelli* temporibus mathematicus paulo insignior; quin aliquid operæ ad ejus incrementum contulerit, sive experimentis instituendis, sive rationibus & argumentis a priori excogitandis.

At plerisque, utut magnis viris, propter summam operis difficultatem, parum feliciter res processit. Nam & theoriam excolentes ea tradiderunt theoremata, quibus factò periculo refragare deprehenditur experientia; & qui experimentis capiendis operam dede-

dederunt, cum animum non adverterent ad circumstantias quasdam minutiores, quod iis quid momenti inesset nondum erat compertum, inde factum est, ut tum singuli magnopere inter se dissideant, tum ab illa *Mensura*, quæ reperiri debuerat, pene omnes insigniter aberrârint.

Cujus rei non aliud luculentius dari potest exemplum, quam simplex illud omniumque facillimum, quod reliquis fere universis pro fundamento esse consuevit, quodque nos idcirco diligentius pertractandum suscepimus, ubi aqua ex vase constanter pleno, constanti velocitate, per foramen circulare in fundo factum decurrit. Hic enim ex omnibus unus *Poelenus* veram tradidit aquæ effluentis *Mensuram*, aut eam saltem, quæ ad veram proxime accedit: unus *Newtonus* verum posuit ejus *Mensuræ* indagandæ fundamentum; verum, at a plerisque repudiatum; a quibusdam, dissimulato auctoris nomine, pro suo venditatum.

His itaque duobus ducibus rem aggredimur, & primo quidem loco, phænomenon nomine proponemus ea, quæ aut ipsis experimentis comparent, aut ex iisdem, certissimis argumentis confirmantur: deinde ad eorum phænomenon solutionem accedemus.

Phænomena effluxus aquæ ex foramine in fundo vasis constanter pleni.

1. Data altitudine aquæ & tempore effluendi, *Mensura* aquæ effluentis est fere in ratione foraminis.

2. Data altitudine aquæ & foramine, *Mensura* aquæ effluentis est in ratione temporis effluendi.

3. Dato

3. Dato tempore effluendi & foramine, *Mensura* aquæ effluentis est fere in ratione subduplicata altitudinis aquæ.

4. *Mensura* aquæ effluentis est fere in ratione composita ex ratione foraminis, ratione temporis, & ratione subduplicata altitudinis aquæ.

5. *Mensura* aquæ dato tempore effluentis longe minor est ea, quæ ex Mathematicorum theorematibus vulgo elicitur. Ea nempe vulgo habetur aquæ effluentis velocitas, quam acquirat in vacuo corpus grave cadendo ex integra altitudine aquæ supra foramen; & hoc posito, si area foraminis vocetur F , A altitudo aquæ supra foramen, V velocitas quam comparat corpus grave cadendo in vacuo ex ista altitudine, T tempus cadendi, & effluat aqua constanti hac velocitate V , per tempus T , erit $2 A$ longitudo columnæ aquæ, quæ eo tempore effluit; eritque ejus *Mensura* $2 AF$. At si accuratissima * *Poleni* experimenta ad calculum revoces, copiam aquæ, quæ eo tempore effluit, non nisi $\frac{571}{1000}$ circiter hujus *Mensuræ* $2 AF$ conficere perspicies.

Hujus autem viri illustrissimi experimenta, cum propter summam ejus diligentiam, & accurationis studium, tum alio etiam nomine, reliquorum omnibus omnium præferenda censeo. Is siquidem deprehendit copiam aquæ effluentis ex vase per tubum cylindricum, eam quæ exiret per foramen circulare in tenui lamina factum, pari existente diametro tubi & foraminis, & pari altitudine aquæ ambobus incum-

* Polenus de Castellis, *Art.* 35, 38, 39, 42, 43.

bentis, longe superare. Idque ita se habere cognovit, cum tubus non fundo quidem, quod alii prius animadverterant, sed lateri vasis infereretur.

Est autem foramen vel in tenui lamina factum, pro brevi tubo cylindrico habendum. Unde patet majorem aquæ copiam ex foramine in lamina tenui facto profluere, quam quæ effluxura fuisset, si, quod aiunt, infinite parva fuisset laminæ crassities. Cujusmodi lamina cum neque haberi, nec etiam cogitatione concipi queat, relinquitur ut augcamus diametrum foraminis, quo laminæ crassities, quam fieri commode potest, minimam rationem obtineat ad foraminis diametrum.

Id vero magno cum judicio præstitit *Polenus*, cum uteretur diametro linearum 26, lamina autem non integram lineam crassa; cum ante cum vix quisquam adhibuerit diametrum 6 aut 7 lineas superantem; aut omnino animum adverterit ad laminæ vel fundi vasis crassitiem, nisi quod unus *Newtonus*, pro summa sua providentia, sese lamina portenui usum fuisse scribat.

Nec foraminum solum, sed vasorum etiam amplitudini *Polenus* supra omnes prospexit, quo aqua liberrime & quam minimo cum impedimento versus foramen descenderet; ut nullus dubitandi locus sit, quin *Mensuræ* ab eo captæ propius longe quam ullæ a reliquis traditæ ad verum accedant.

6. Cum, ut modo vidimus, *Mensura* aquæ effluentis prædicto tempore T , sit $2 AF \times \frac{571}{1000}$, est longitudo columnæ aquæ, quæ eo tempore effluit, $2 A \times \frac{571}{1000}$. Itaque, si particulæ aquæ, quæ eodem temporis

poris puncto in foramine versantur, singulæ pari velocitate prosiliant, liquet communem omnium velocitatem eam esse, qua percurratur tempore T spatium $2A \times \frac{571}{1000}$, sive velocitatem $V \times \frac{571}{1000}$. Hæc autem

ea est, quacum aqua in vacuo prosilire possit ad tertiam fere partem altitudinis aquæ supra foramen.

7. Atqui, cum sursum vertitur aquæ motus, ut in fontibus salientibus, prosilire cernuntur fontes ad altitudinem aquæ in cisterna pene integram. Prosilit ergo ex foramine aqua, aut aliqua saltem aquæ portio, cum velocitate V pene integra, certe velocitate multo majori quam $V \times \frac{571}{1000}$.

8. Hinc certissime liquet particulas aqueas, quæ eodem temporis puncto in foramine versantur, non omnes erumpere cum eadem velocitate, sive nullam esse velocitatem omnibus communem. Contrarium hæcenus pro indubitato habuerunt Mathematici.

9. Ad parvam a foramine distantiam, venæ aqueæ erumpentis diameter multo minor est diametro foraminis. Nempe, si foraminis diameter sit 1, erit venæ aqueæ diameter $\frac{21}{25}$, sive 0,84 mensurante *Newtono*, qui mirabile hoc phænomenon primus animadvertit; ex mensuris *Poleno* captis erit $\frac{20}{26}$, vel $\frac{20,5}{26}$; hoc est, si diametrum intermediam ceperis, 0,78 fere.

His expositis, progrediendum est deinceps ad solutionem horum phænomenon expediendam: id vero antequam fiat, ex usu erit lectorem pauca præmonere.

1. Aquam nos non aliter consideramus, quàm ut corpus fluidum, continuum, cujus partes vi minimæ illatæ cedunt, & cedendo moventur inter se.

2. Per aquam effluentem intelligimus eam aquæ copiam, quæ actu ex foramine egreditur: Quod, etsi minus necessarium videri possit, monendum tamen idcirco duximus, quod in *Dissertatione* nostra de *Motu aquarum fluentium* ante annos circiter 24 *Actis Philosophicis* inserta, aquæ defluentis nomine designata fuerit tota illa aquæ copia, quæ intra vas in motu constituta est, & versus foramen descendit.

3. Vasis amplitudinem pro infinita habemus, aut tanta saltem, ut in eo decrementum altitudinis aquæ toto temporis spatio, quo aqua ex foramine effluit, sensu percipi nequeat.

4. Aquam consideramus ut effluentem constanti velocitate. Nimirum ipso motus initio per minimum temporis spatium effluit aqua minori velocitate, quam mox elapsura sit. Nos autem ipsum motus initium præterimus, & tum demum investigamus aquæ *Mensuram* & *Motum*, cum integram velocitatem, quanta fieri potest, comparaverit. Hæc autem constans sit, necesse est, dum constet aquæ superincumbentis altitudo.

5. Fundum vasis non aliter concipimus quam ut planum mathematicum, vel laminam saltem eatenus tenuem, ut ejus crassities quasi nulla sit respectu diametri foraminis.

6. Per *Mensuram aquæ effluentis* in sequentibus semper intelligimus eam aquæ copiam, quæ ex foramine erumpit illo temporis spatio, quo corpus grave in vacuo cadens percursum sit altitudinem aquæ supra foramen.

7. Per

7. Per *Motum aquæ effluentis* intelligimus summam motuum omnium aquæ particularum, quæ supradicto temporis spatio ex foramine erumpunt. Motus vero cujusque particulæ est, ut factum ex ipsa particula & velocitate quacum ex foramine erumpit.

8. Quo facilius animo concipiantur sequentia, casus simplices primo proponemus, deinde ad magis compositos, sed propius ad verum rerum statum accedentes, progrediemur.

Nempe in problemate primo, quo simplicior evadat solutio, ponimus aquam ex foramine in vacuum effluere, aqueasque particulas, dum versus foramen descendunt, omni carere resistantia ex defectu lubricitatis oriunda.

In secundo & tertio problemate ponitur adhuc effluxus aquæ in vacuo institui; sed concipimus particulas aqueas, dum versus foramen descendunt, nonnullam ex defectu lubricitatis experiri resistantiam, tantulam tamen, ut decrementum *Motus* aquæ ex foramine effluentis, exinde ortum, pro nihilo haberi possit.

In quarto & quinto, vacui positionem adhuc retinemus; at sensibile ponitur decrementum *Motus* aquæ effluentis, ex defectu lubricitatis.

Tandem in problemate sexto & sequentibus rem consideramus prout revera se habet, cum in aëre res transigitur, adeo ut particulæ aquæ resistantiam sensibilem patiantur, non modo a sese invicem per defectum lubricitatis, intra vas, sed etiam post exitum e vase, per attritum aëris ambientis.

P R O B L E M A I.

Definire Motum, Mensuram, & velocitatem aquæ in vacuum effluentis per foramen in fundo vasis, ubi particule aquæ nullam patiuntur resistantiam ex defectu lubricitatis.

Dum foramen obturaculo occluditur, sustinet obturaculum pondus columnæ aquæ ipsi ad perpendicularum incumbentis. Remoto obturaculo, columna aquæ foramini ad perpendicularum imminens, cum non amplius sustineatur, pressione sua efficiet, ut aqua per foramen defluat, & postquam eam ad debitam velocitatem compulerit, deinceps constanti sua pressione constantem aquæ effluentis velocitatem conservabit.

Concipiendum est quidem, *Motum* aquæ ex foramine effluentis non a pondere solius columnæ perpendicularis ortum ducere, sed partim ex hujus columnæ pressione, partim ex pressione aquæ circumpositæ derivari. Sed hoc pacto neque major neque minor sit *Motus* aquæ effluentis, quam si ex pressione solius columnæ perpendicularis oriretur: Non minor, quia pressio columnæ perpendicularis, si non impediatur, *Motum* sibi proportionalem generabit, impediri autem non potest nisi quatenus aqua circumposita urget aquam effluentem: non major, quia pressio aquæ circumpositæ non potest aliquid conferre ad *Motum* aquæ effluentis, nisi tantundem demat ex pressione columnæ perpendicularis.

Causa igitur adæquata *Motus* aquæ ex foramine effluentis, est pressio sive pondus columnæ aquæ, quæ foramini insistit. At vis data, quocunque modo

applicetur, dato tempore datam generat *Motus* quantitatem versus easdem partes, quo tendit vis. Parem itaque *Motus* quantitatem dato tempore generat columnæ incumbētis pondus in aqua effluente, atque generare posset eodem tempore in ipsa columna libere per vacuum cadente.

Jam quoniam, per hypothesin, particulæ aqueæ nullam experiuntur resistantiam ex defectu lubricitatis, & omnes illæ particulæ, quæ jamjam exituræ in ipso foramine versantur, æquali urgentur pressione aquæ superincumbētis, liquet harum omnium æqualem esse velocitatem.

Sit v communis ista velocitas; a altitudo unde cadendo in vacuo comparetur ea velocitas; A altitudo aquæ supra foramen; V velocitas quæ comparetur cadendo in vacuo ex altitudine A ; T tempus cadendi ex eadem altitudine; F area foraminis; & effluat aqua ex foramine per tempus T .

Jam quoniam tempore T velocitate V percurratur spatium $2A$, percurreretur eodem tempore velocitate v spatium $\frac{2Av}{V}$. Hæc itaque erit longitudo columnæ

aqueæ, quæ effluit ex foramine tempore T ; eritque magnitudo hujus columnæ, sive *Mensura* aquæ effluentis tempore T , $\frac{2AvF}{V}$, & *Motus* ejusdem erit

$$\frac{2AFv^2}{V}.$$

Motus autem, qui eodem tempore T , in columna aquea foramini insistente generari possit, si suo ipsius pondere per vacuum feratur, sic habetur,

Erit ejus velocitas V , & cum magnitudo ejusdem sit AF , erit ejus *Motus* AFV .

Atqui *Motus* iste, ex suprapositis, æqualis est *Motui* columnæ aquæ effluentis tempore T , sive $AFV = \frac{2AFv^2}{V}$.

Hinc autem $V = \frac{2v^2}{V}$, sive $v^2 = \frac{V^2}{2}$, & $v = \frac{V}{\sqrt{2}}$.

Porro *Mensura* supraposita aquæ effluentis tempore T , sive $\frac{2AFv}{V} = \frac{2AF}{V} \times \frac{V}{\sqrt{2}} = \frac{2AF}{\sqrt{2}} = AF \times \sqrt{2}$. Q. E. I.

COROLL. I. Cum sit $a : \dot{A} :: v^2 : V^2$, erit $a = \frac{Av^2}{V^2}$, hoc est, $a = \frac{A}{V^2} \times \frac{V^2}{2}$, sive $a = \frac{A}{2}$. Itaque altitudo a , quam effluens aqua motu sursum verso attingere queat, dimidia est altitudo aquæ in vase supra foramen. Quæ est ipsa altitudo *Newtono* definita *Prop. 36. Lib. II. Princip.* Editionis primæ.

COROLL. II. Si tribuatur aquæ effluentis ea velocitas, quæ comparatur cadendo ex integra altitudine aquæ supra foramen, hoc est, si ponatur velocitas $v = V$, erit *Motus* aquæ supra definitus $\frac{2AFv^2}{V} = 2AFV$, sive du plus ejus *Motus*, qui a columna foramini incumbente generari possit, & proinde non nisi a duplo hujus columnæ generandus; quod docuit *Newtonus Corollario secundo, Prop. 36. Lib. II. Princip. Edit. 2 & 3.*

SCHOLIUM.

Mensura hic determinata, $\frac{2AF}{\sqrt{2}}$, sive $2AF \times$

0,707, ut longe deficit ab ea, quæ vulgo Mathematicis statuitur, nempe $2AF$, ita longe superat illam *Mensuram*, quam exhibent *Poleni* experimenta, sive $2AF \times 0,571$. Nec mirum: quod enim ponitur in hoc problemate, carere omni resistantia particulas aqueas inter defluendum, hypothesis est a vero rerum statu aliena.

PROBLEMA II.

Definire Motum, Mensuram & velocitatem aquæ in vacuum effluentis per foramen circolare in medio fundo vasis cylindrici, ubi particule aquæ resistantiam patiuntur ex defectu lubricitatis, sed tam parvam, ut decrementum Motus aquæ effluentis exinde ortum pro nihilo haberi possit.

Sit vas cylindricum immensum $ABCD$, Fig. 1. EF foramen circolare in medio fundo factum, & aqua in hoc vase quiescente prorsus & immota, detrahatur obturaculum a foramine, ut pateat exitus aquæ per foramen.

Tum quoniam aqua hætenus immota fuerit, & jam per foramen effluere incipit, & effluentem sequitur aqua supraposita, & motus naturalis aquæ nulla desuper affusione perturbatur, & foramen obtinet ipsum fundi medium, induet sese necessario illa aquæ portio, quæ in motu versatur, & versus foramen descendit,

in

in figuram aliquam regularem *AHEFKB*, cujus basis inferior sit ipsum foramen, basis autem superior sit superficies aquæ suprema *AB*, & sectiones omnes horizontales sint circulares. Hanc vocamus *Cataractam*; qualis autem sit *Cataractæ* figura, nondum disputamus: in præsentî sufficit nostro instituto, ut animadvertamus regularem esse, & per singulas ejus sectiones horizontales eandem aquæ copiam dato tempore transire.

Jam quoniam omnis illa aqua, quæ deorsum fertur, *Cataracta* continetur, patet reliquam aquam *AHEC, BKFD*, quæ extra *Cataractam* sita est, omni motu carere, & penitus quiescere. Itaque in sectione quavis horizontali *Cataractæ HcK*, cujus centrum *c*, puncta *H, K* repræsentabunt limites inter aquam descendantem versus foramen, & aquam circumpositam quiescentem.

Porro, cum punctum *K* sit limes motus & quietis, & particulæ aquæ, dum moventur inter se, resistantiam patiantur ex defectu lubricitatis, particula aquæ α , Fig. 2. intra *Cataractam* sita, & adjacens puncto *K*, non poterit nisi quam minima velocitate deorsum ferri. Alioqui, necessario secum abriperet particulam proximam a extra *Cataractam* positam, contra hypothefin. Particula autem β , quæ particulæ α introrsum contigua est, nonnisi quam minima velocitate relativa descendet respectu particulæ α ; cum alioqui particulam α accelerando eam secum abriperet, & hæc particula α , jam celerius mota, abriperet secum particulam a . Pariter particula γ magis introrsum posita, & particulæ β contigua, descendet quam minima velocitate relativa respectu particulæ β ; & reliquæ particulæ δ, ϵ , &c. aliæ aliis magis introrsum sitæ, descendent

dent velocitate quam minima relativa respectu particularum singulis extrorsum adjacentium. Hac autem ratione velocitas absoluta particularum crescat necesse est gradatim a limite versus centrum c , ut velocitas aquæ sit maxima in ipso centro, minima in limite utroque K & H .

Necesse vero est, ut resistentia, quam experitur particula quæque celerior ex affricu adjacentis particulæ tardioris extrorsum positæ, perpetuo sibi æqualis sit per totam sectionem *Cataractæ*. Alioqui, particula illa, quæ majorem patitur resistentiam, accelerabit particulam tardiozem adjacentem, donec minuatur hoc pacto resistentia, & fiat æqualis illi resistentiæ, quam patiuntur cæteræ particulæ. At si resistentia sit ubique sibi æqualis per totam *Cataractæ* sectionem, erit & velocitas relativa particularum ubique æqualis, cum altera alteram necessario consequatur.

Ergo velocitas absoluta cujuslibet particulæ, quæ est summa velocitatum omnium relativarum ab ambitu sectionis ad eam usque particulam simul sumptarum, est in ratione distantia ejusdem particulæ ab ambitu *Cataractæ*.

His expositis, sit modo r radius foraminis, m ad 1 in ratione peripheriæ ad diametrum, mr^2 area foraminis, v velocitas quacum aqua descendit in centro foraminis, a altitudo unde cadendo in vacuo comparetur velocitas v , A altitudo aquæ supra foramen, V velocitas quæ comparetur cadendo in vacuo ex altitudine A , T tempus cadendi ex eadem, z distantia cujuslibet particulæ a centro foraminis, & effluat aqua tempore T .

Jam *Mensura* aquæ, quæ tempore T ex foramine egreditur, ad hunc modum invenietur.

Erit z radius circuli cujuslibet intra foramen, $2mz$ circumferentia ejusdem, $2mz \cdot z$ annulus nascens ei circumferentiæ adjacens, $\frac{v \times r - z}{r}$ velocitas aquæ in annulo nascente.

Cumque sit $V : v \times \frac{r - z}{r} :: 2A : \frac{2Av \times r - z}{Vr}$
erit $\frac{2Av \times r - z}{Vr}$ spatium, quod conficit aqua per annulum nascentem fluens tempore T , & *Mensura* ejusdem aquæ erit $2mz \cdot z \times \frac{2Av \times r - z}{Vr} =$
 $\frac{4mAv \times rz - z^2z}{Vr}$.

At *Mensura* aquæ per annulum nascentem transeuntis est fluxio *Mensuræ* aquæ transeuntis per circulum, cui radius z . Est itaque *Mensura* aquæ, quæ tempore T transít per hunc circulum, quantitas fluens

fluxionis modo expositæ $\frac{4mAv}{Vr} \times rz - z^2z$, i. e.

$$\frac{4mAv}{Vr} \times \frac{3rz^2 - z^3}{6} = \frac{2mAv}{3Vr} \times 3rz^2 - 2z^3.$$

Et ponendo $z = r$, habebitur *Mensura* aquæ per totum foramen transeuntis tempore T , nempe $\frac{2mAvr^2}{3V}$.

Motus vero aquæ ejusdem sic habebitur.

Mensura

Mensura aquæ tempore T effluentis per annulum nascentem est, ut modo perspeximus, $\frac{4 m A v}{V r} \times \overline{r z \dot{z} - z^2 \dot{z}}$, & cum velocitas ejusdem sit $v \times \frac{r - z}{r}$, erit ejus *Motus* $\frac{4 m A v}{V r} \times \overline{r z \dot{z} - 2 z^2 \dot{z}} \times \frac{v}{r} \times \overline{r - z} = \frac{4 m A v^2}{V r^2} \times \overline{r^2 z \dot{z} - 2 r z^2 \dot{z} \times z^3 \dot{z}}$, cujus quantitas fluens est $\frac{4 m A v^2}{V r^2} \times \frac{r^2 z^2}{2} - \frac{2 r z^3}{3} + \frac{z^4}{4} = \frac{m A v^2}{3 V r^2} \times \overline{6 r^2 z^2 - 8 r z^3 + 3 z^4}$, qui est *Motus* aquæ transfuentis per circulum cui radius z . Et posita $z = r$, habetur *Motus* aquæ effluentis tempore T per totum foramen, $\frac{m A v^2 r^2}{3 V}$.

Hic autem *Motus*, per solutionem *Problematis* primi, & hypothesein hujus, æqualis est *Motui*, quem columna foramini insitens comparare possit eodem tempore T , suo ipsius pondere per vacuum cadendo, hoc est, *Motui* AFV , sive $AV \times m r^2$. Itaque $\frac{m A v^2 r^2}{3 V} = m A V r^2$.

Hinc autem $v^2 = 3 V^2$, & $v = V \times \sqrt{3}$.

Porro *Mensura* supraposita aquæ effluentis per foramen tempore T , nempe $\frac{2 m A v r^2}{3 V} = \frac{2 m A r^2}{3 V} \times V \times \sqrt{3} = \frac{2 A m r^2}{\sqrt{3}}$. Q. E. I.

COROLL. I. Cum sit $V^2 : v^2 :: A : a$, erit $a = \frac{A v^2}{V^2} = \frac{A}{V^2} \times 3 V^2 = 3 A$. Itaque altitudo, ad quam aqua in vacuo proflire possit ea velocitate, quacum effluit in centro foraminis, tripla est altitudinis aquæ supra foramen.

COROLL. II. *Cataractæ* figura ad hunc modum definitur:

Sit HK , Fig. 3. quælibet sectio *Cataractæ*, cujus centrum c , sitque ejus radius $cK = y$, altitudo aquæ supra istam sectionem, sive $Ic = x$, t tempus cadendi in vacuo ex altitudine x , sitque, ut prius, $LF = r$, & $IL = A$.

Jam transit aqua per hanc sectionem HK eadem copia atque effluit ex foramine EF .

Quod si vas eo usque decurtetur, ut ejus altitudo redigatur ex IL ad Ic , adeoque sectio ista HK jam fiat ipsum foramen in fundo vasis, transibit aqua dato tempore, per hanc sectionem, copia neque majori, neque minori, atque prius transierat per eandem, vase nondum decurtato: non majori, quia non urgetur ista sectio nisi eodem columnæ superincumbentis pondere, quo prius urgebatur; non minori, quia aqua inferior $HKFE$ non obstat motui aquæ per sectionem HK transituræ.

Vase autem decurtato, *Mensura* aquæ effluentis ex foramine HK tempore t , per solutionem præcedentem, est $\frac{2 x m y^2}{\sqrt{3}}$, & *Mensura* aquæ effluentis tempore

T est $\frac{2 x m y^2}{\sqrt{3}} \times \frac{T}{t} = \frac{2 x m y^2}{\sqrt{3}} \times \frac{\sqrt{A}}{\sqrt{x}}$. Nam $T : t :: \sqrt{A} : \sqrt{x}$.

Sed,

Sed, ex supradictis, *Mensura* aquæ tempore dato *T* effluentis ex foramine *HK* vase decurtato, æqualis est *Mensura* aquæ eodem tempore transeuntis per sectionem *HK* vase integro, sive *Mensura* aquæ eodem tempore effluentis ex foramine *EF*. Itaque $\frac{2 x m y^2}{\sqrt{3}} \times \frac{\sqrt{A}}{\sqrt{x}} = \frac{2 A m r^2}{\sqrt{3}}$, sive $y^2 \sqrt{x} = r^2 \sqrt{A}$, vel $y^4 x = r^4 A$, quæ est ipsa æquatio curvæ hyperbolicæ, cujus rotatione figuram *Cataractæ* gigni olim ostendimus in *Actis Philosophicis* Numero 355.

SCHOLIUM I.

Mensura aquæ supra inventa $\frac{2 A m r^2}{\sqrt{3}}$, sive $2 A m r^2 \times 0,577350$ tantillo major est *Mensura* $2 A m r^2 \times 0,571$, quæ ex Cl. *Poleni* experimentis elicitur. Hoc autem differentiæ, aliqua saltem ex parte, inde provenit, quod in hoc problemate decrementum *Motus* aquæ ex resistentia ortum pro nihilo habuimus.

SCHOLIUM II.

Recte se habet *Mensura* aquæ effluentis hac solutione definita, si altitudinem vasis pro infinite magna habeamus respectu diametri foraminis. Cum vero hæc altitudo finitam rationem obtinet ad diametrum foraminis, paulo minor erit *Mensura*, ita tamen, ut cum altitudo quinquies major sit diametro, non nisi parte $\frac{1}{32000}$, & cum dupla sit diametri, non nisi parte $\frac{1}{5120}$ circiter, a vero aberret, quæ differentiæ minores

nones sunt quam ut ullo experimento deprehendi queant.

Tantillum autem hoc discrimen exinde proficiscitur, quod velocitas supradicta relativa, & proinde ipsa velocitas absoluta particularum aquæ, quas consideravimus ut in directione ad horizontem perpendiculari, revera obtinent directionem paululum obliquam, cum propius ad axem *Cataractæ* accedat quæque particula inter descendendum.

Quod si aliquis desiderio teneatur solutionem veram & accuratam consequendi, cum altitudo aquæ quamcunque rationem obtinet ad diametrum foraminis, eam hunc in modum consequi poterit.

Ex curvæ *Cataracticæ* proprietate corollario secundo hujus problematis exposita, qua $y^4 x = r^4 A$, subtangens hujus curvæ ad ambitum foraminis invenitur $4 A$, & ad ambitum cujuscunque sectionis subtangens erit $4 x$, æqualis scilicet altitudini aquæ supra illam sectionem quater sumptæ.

Curvam vero ejusmodi *Cataracticam* describit non modo aqua exterior, quæ foraminis ambitum præterfluit, sed etiam illa pars aquæ, quæ per quemlibet foraminis annulum effluit; i. e. unaquæque particula aquea curvam ejusmodi describit.

Sit modo z distantia cujuscunque particulæ in foramine positæ, a centro foraminis, & descendat hæc particula per spatium quam minimum in tangente ad curvam *Cataracticam*. Hinc erit ejus velocitas in directione hujus tangentis, sive velocitas $v \times \frac{r-z}{r}$,

quæ in hoc problemate exposita est, ad velocitatem ejusdem in directione ad horizontem perpendiculari, ut $\sqrt{16 A^2 + z^2} : 4 A$.

Est itaque velocitas in directione ad horizontem perpendiculari, $v \times r - z \times \frac{4A}{\sqrt{16A^2 + z^2}}$.

Hinc autem, insistendo vestigiis solutionis superioris, habebis pro *Mensura* aquæ per annulum nascentem transeuntis, $\frac{16mA^2v}{rV} \times \frac{rz - z^2}{\sqrt{16A^2 + z^2}}$.

Hujus vero fluxionis quantitas fluens, per *Mensuras* rationum *Cotesianas*, Form. V. & VI. invenietur

$$\frac{16mA^2v}{rV} \times \frac{2r-z}{2} \sqrt{16A^2 + z^2} + 8A^2 \frac{z + \sqrt{16A^2 + z^2}}{4A};$$

& ponendo primum $z = 0$, deinde $z = r$, habebis

$$\frac{16mA^2v}{rV} \times \frac{r}{2} \sqrt{16A^2 + r^2} - 4Ar + 8A^2 \left| \frac{r + \sqrt{16A^2 + r^2}}{4A} \right|$$

pro *Mensura* aquæ per totum foramen transeuntis tempore T .

Porro, similem in modum procedendo, habebis pro *Motu* aquæ per annulum nascentem transeuntis,

$$\frac{64mA^3v^2}{r^2V} \times \frac{r^2z - 2rz^2 + z^3}{16A^2 + z^2}, \text{ cujus fluxionis}$$

quantitas fluens, per Formam I. & II. *Cotesianam*, repe-

$$\text{rietur } \frac{64mA^3v^2}{r^2V} \text{ in } \frac{z^2 - 4rz}{2} + \frac{r^2}{2} \frac{16A^2 + z^2}{16A^2}$$

$$16A^2 \frac{16A^2 + z^2}{16A^2} + 2r\sqrt{16A^2 + z^2} \left| \frac{z + \sqrt{16A^2 + z^2}}{\sqrt{16A^2 + z^2}} \right|$$

$$\text{\& ponendo } z = r, \text{ habebis } \frac{64mA^3v^2}{r^2V} \text{ in } \frac{r^2 - 16A^2}{2}$$

$$\frac{16A^2 + r^2}{16A^2} + 2r\sqrt{16A^2 + r^2} \left| \frac{r + \sqrt{16A^2 + r^2}}{\sqrt{16A^2 + r^2}} \right| - 3r^2$$

qui

qui est *Motus* aquæ transeuntis per foramen tempore T .

$$\text{Sit jam } M = \frac{r}{2} \sqrt{16 A^2 + r^2},$$

$$N = 8 A^2 + \frac{\sqrt{16 A^2 + r^2}}{4 A}, \text{ vel}$$

$$N = 4 A^2 \left| \frac{16 A^2 + 2 r^2 + 2 r \sqrt{16 A^2 + r^2}}{16 A^2} \right|,$$

$$\frac{r^2 - 16 A^2}{2} \left| \frac{16 A^2 + r^2}{16 A^2} \right|, \&$$

$$L = 2 r \sqrt{-16 A^2} \left| \frac{r + \sqrt{-16 A^2}}{\sqrt{16 A^2 + r^2}} \right|, \text{ vel}$$

$L = 2 r \times 4 A$ (Rad : Tang : Sec :: $4 A : r : \sqrt{16 A^2 + r^2}$), & *Mensura* aquæ per foramen transeuntis tempore T , erit $\frac{16 m A^2 v}{r V} \times \overline{M + N - 4 A r}$;

Motus vero ejusdem aquæ erit $\frac{64 m A^3 v^2}{r^2 V} \times \overline{L + K - 3 r^2}$.

$$\text{Sed } \frac{64 m A^3 v^2}{r^2 V} \times \overline{L + K - \frac{3 r^2}{2}} = m r^2 A V, \text{ unde}$$

$$v^2 = \frac{r^4 V^2}{64 A^2 \times \overline{L + K - \frac{3 r^2}{2}}} \& \text{ *Mensura* aquæ per}$$

foramen effluentis tempore T , est $2 m A r \times \frac{\overline{M + N - 4 A r}}{\overline{L + K - \frac{3 r^2}{2}}}$.

Sin autem pro Mensuris rationum & angulorum adhibere malis series infinitas, erit supraposita *Mensura* aquæ per anulum nascentem effluentis, $\frac{16 m A^2 v}{r V}$

$\times \frac{r z \dot{z} - z^2 \dot{z}}{\sqrt{16 A^2 + z^2}}$, ad hanc formam reducenda, $\frac{m v}{r V}$

$\times \frac{r z \dot{z} - z^2 \dot{z}}{\sqrt{16 A^2 + z^2}} \times \frac{16 A^2}{\sqrt{16 A^2 + z^2}}$; & reducendo

$\frac{16 A^2}{\sqrt{16 A^2 + z^2}}$ ad seriem infinitam, habebis $\frac{m v}{r V}$

$\times r z \dot{z} - z^2 \dot{z}$ in $4 A - \frac{z^2}{8 A} + \frac{3 z^4}{8^3 A^3} - \frac{5 z^6}{4 \times 8^4 A^5} +$
 $\frac{35 z^8}{8^7 A^7} - \&c.$ pro *Mensura* aquæ per anulum nascentem effluentis; & per hujus fluxionis quantitatem fluentem, sive per $\frac{m v}{V}$ in $\frac{2 A r^2}{3} - \frac{r^4}{20 \times 8 A} + \frac{r^6}{14 \times 8^3 A^3}$

$- \frac{5 r^8}{36 \times 8^5 A^5} + \frac{7 r^{10}}{22 \times 8^7 A^7} - \&c.$ exponetur *Mensura* aquæ effluentis per foramen integrum.

Porro *Motus* suprapositus aquæ per anulum nascentem transcurrentis, $\frac{64 m A^3 v^2}{r^2 V} \times \frac{r^2 z \dot{z} - 2 r z^2 \dot{z} + z^3 \dot{z}}{16 A^2 + z^2}$

$= \frac{4 m A v^2}{r^2 V} \times \frac{r^2 z \dot{z} - 2 r z^2 \dot{z} + z^3 \dot{z}}{\sqrt{16 A^2 + z^2}} \times \frac{16 A^2}{\sqrt{16 A^2 + z^2}}$

$= \frac{4 m A v^2}{r^2 V} \times \frac{r^2 z \dot{z} - 2 r z^2 \dot{z} + z^3 \dot{z}}{\sqrt{16 A^2 + z^2}} \sin 1 - \frac{z^2}{16 A^2}$

$+ \frac{z^4}{16^2 A^4} - \frac{z^6}{16^3 A^6} + \frac{z^8}{16^4 A^8} - \frac{z^{10}}{16^5 A^{10}} + \&c.$

Et per fluxionis hujus quantitatem fluentem, five per

$$\frac{4mAv^2}{V} \text{ in } \frac{r^2}{12} - \frac{r^4}{60 \times 16 A^2} + \frac{r^6}{168 \times 16^2 A^4} - \frac{r^8}{360 \times 16^3 A^6} + \frac{r^{10}}{660 \times 16^4 A^8} - \&c. \text{ exponetur Motus} \\ \text{aquæ per foramen integrum effluentis.}$$

$$\text{Ergo } Amr^2 V = \frac{4mAv^2}{V} \text{ in } \frac{r^2}{12} - \frac{r^4}{60 \times 16 A^2} + \&c.$$

$$\text{five } V^2 = v^2 \text{ in } \frac{1}{3} - \frac{r^2}{15 \times 16 A^2} + \&c. \text{ vel}$$

$$v^2 = \frac{V^2}{\frac{1}{3} - \frac{r^2}{15 \times 16 A^2} + \&c.}$$

$$\&c. v = \sqrt{\frac{1}{\frac{1}{3} - \frac{r^2}{15 \times 16 A^2} + \&c.}}$$

Unde *Mensura* aquæ effluentis per foramen, five

$$\frac{mv}{V} \text{ in } \frac{2Ar^2}{3} - \frac{r^4}{20 \times 8 A} + \frac{r^6}{14 \times 8^3 A^3} - \frac{5r^8}{36 \times 8^5 A^5} + \&c. \\ = \frac{m}{V} \text{ in } \frac{2Ar^2}{3} - \frac{r^4}{20 \times 8 A} + \frac{r^6}{14 \times 8^3 A^3} - \frac{5r^8}{36 \times 8^5 A^5} + \&c.$$

$$\times \sqrt{\frac{1}{\frac{1}{3} - \frac{r^2}{15 \times 16 A^2} + \&c.}}$$

$$= m \text{ in } \frac{2Ar^2}{3} - \frac{r^4}{20 \times 8 A} + \&c.$$

$$\sqrt{\frac{1}{\frac{1}{3} - \frac{r^2}{15 \times 16 A^2} + \&c.}}$$

$$\text{Unde tandem } \textit{Mensura} \text{ aquæ effluentis per foramen} \\ \text{habetur } \frac{2Amr^2}{\sqrt{3}} \text{ in } 1 - \frac{r^2}{20 \times 16 A^2} + \frac{r^4}{56 \times 16^2 A^4} - \&c.$$

Hinc

Hinc ponendo A infinitam respectu diametri foraminis, evadit $Mensura = \frac{2 A m r^2}{\sqrt{3}}$, ut in *Problemate* hoc determinavimus.

Cum $A = 10 r$, $Mensura = \frac{2 A m r^2}{\sqrt{3}} \times 1 - \frac{1}{32000}$ circiter.

Cum $A = 4 r$, $Mensura = \frac{2 A m r^2}{\sqrt{3}} \times 1 - \frac{1}{5120}$ circiter.

Potest itaque loco veræ *Mensuræ* adhiberi $Mensura \frac{2 A m r^2}{\sqrt{3}}$, sine periculo sensibilis erroris, etiam in tantula altitudine, multo magis in altitudine multis vicibus majori, qualis fere in experimentis adhiberi consuevit; & hoc pacto computus ex operoso admodum & intricato facillimus evadit.

PROBLEMA III.

Isdem positis, & negligendo accelerationem aquæ extræ foramen, determinare diametrum venæ aquæ ad parvam distantiam extræ foramen, ubi vena maxime contrahitur, & velocitatem aquæ in vena sic contracta.

In problematis superioris solutione ostensum fuit, particulas aqueas ex foramine erumpentes non una omnibus communi velocitate profilire, sed eo velocius ferri, quo propius absunt a centro foraminis; & velocitatem relativam particularum interiorum, respectu particularum singulas extrorsum contingentium, con-

stanter sibi æqualem fieri per totum foramen; & relativam hanc velocitatem proficisci ex resistantia, quam ab aqua circumposita patitur aqua versus foramen descendens.

At postquam aqua ex foramine egressa est, ejusque superficies exterior nullam jam patitur resistantiam ab aqua circumposita, nec etiam ab aëre ambiente, quippe quæ ex hypothese per vacuum feratur, fieri nequit ut amplius perslet illa velocitas relativa, aut velocitatis absolutæ inæqualitas. Jam enim particule celeriores accelerent necesse est particulas tardiores contiguas, & ipsæ vicissim a tardioribus retardentur, donec universæ unicam velocitatem sortitæ fuerint particulis omnibus communem; quod intra parvum spatium fiet, postquam ex foramine fuerint egressæ.

Dum vero communem hanc velocitatem consequuntur omnes particule, contrahitur necessario venæ diameter. Similiter nempe hic res accidit, atque cum flumen rapidius cum tardiori, *Rhodanus* puta cum *Arare*, conjungitur. In alveo communi par est velocitas aquæ ex utroque flumine advectæ, & pari copia transmittitur aqua per sectionem hujus alvei, atque prius transmissa fuerat per sectiones fluminum amborum: Sed longe minor est *Rhodani* sectio post *Aram* receptum, quam summa sectionum *Rhodani* & *Araris*, priusquam confluant.

Sit igitur venæ aqueæ contractæ, ubi omnes particule in eadem venæ sectione sitæ æqualem velocitatem adeptæ fuerint, radius ρ , & communis ista velocitas vocetur v .

Jam *Mensura* aquæ per venæ contractæ sectionem transfluentis tempore T sic habebitur.

Est $V : v :: 2A : \frac{2Av}{V}$, quæ est longitudo venæ aqueæ per hanc sectionem transeuntis tempore T . Estque $\frac{2Av}{V} \times m g^2$ *Mensura* aquæ per hanc sectionem transeuntis eodem tempore.

Et *Motus* aquæ per sectionem venæ transeuntis tempore T , est $\frac{2Av}{V} \times m g^2 \times v$, sive $\frac{2Amg^2v^2}{V}$.

Atqui *Mensura* aquæ per venæ sectionem transeuntis æqualis est *Mensura* aquæ per foramen eodem tempore effluentis, hoc est, $\frac{2Amg^2v}{V} = \frac{2Amr^2}{\sqrt{3}}$, sive $2g^2v = \frac{2r^2V}{\sqrt{3}}$.

Porro *Motus* aquæ ex foramine erumpentis, cum non mutetur ex actione particularum inter se, æqualis erit *Motui* aquæ per venæ sectionem transluentis, hoc est $AVmr^2 = \frac{2Amg^2v^2}{V}$, sive $2g^2v^2 = r^2V^2$.

Est autem $v = \frac{2g^2v^2}{2g^2v} = r^2V^2 \times \frac{\sqrt{3}}{2r^2V}$, hoc est $= \frac{V\sqrt{3}}{2}$, & $v^2 = \frac{3V^2}{4}$.

Et $g^2 = \frac{r^2V^2}{2v^2} = \frac{r^2V^2}{2} \times \frac{4}{3V^2}$, sive $g^2 = \frac{2r^2}{3}$.

& $g = \frac{r\sqrt{2}}{\sqrt{3}}$. Q. E. L.

COROLL. Cum sit $v^2 = \frac{3V^2}{4}$, altitudines autem sint in ratione duplicata velocitatum inde cadendo
geni-

genitarum, patet eam esse velocitatem aquæ in vena contracta, qua sursum profilire queat in vacuo ad tres quartas partes altitudinis aquæ supra foramen.

SCHOLIUM I.

Mirabilem hanc venæ aquæ contractionem primus omnium, ante annos fere 30, animadvertit *Newtonus*, cum occasione difficultatum quarundam ab altero illo *Britanniæ* lumine, & amico nostro nullis unquam lacrymis satis deflendo, *Rogero Cotesio*, propositarum, qui tunc temporis secundam *Principiorum* editionem adornabat, attentius in motum aquæ effluentis introspiceret: eandem postea pluribus experimentis confirmavit *Polenus*. Exinde philosophorum ingenia satis superque exercuit hoc phenomenon: sed omnes hactenus latuit vera causa hujus contractionis.

Radius autem venæ hoc problemate definitus, nempe $\frac{r\sqrt{2}}{\sqrt{3}}$, sive $r \times 0,8165$, paulo minor est radio $r \times 0,84$, quanta a *Newtono* traditur; paulo major radio $r \times 0,78$, qualis fere *Poleno* mensuranti contigit, estque pene inter utramque intermedia.

At velocitas supra determinata $\frac{V\sqrt{3}}{2}$, qua profilire sursum possit aqua ad tres quartas partes altitudinis vasis supra foramen, longe abest ab experimentis, quibus reperiuntur fontes salientes ad integram fere cisternæ altitudinem adsurgere. Provenit autem istud velocitatis discrimen ex aëris ambientis resistentia, quæ tantum abest ut minuat altitudinem salientium, quod vulgo creditur, eandem non parum auget, id quod ex *Problematis* septimi solutione patebit.

SCHOLIUM II.

Ex iis, quæ supra exposuimus in *Scholio* 2. *Problematis* II. patet valores hosce ipsarum ρ & v , pro accuratis haberi non posse, nisi altitudo aquæ pro infinita habeatur respectu diametri foraminis, proxime tamen ad veros valores accedere, si altitudo aquæ sit diametri foraminis dupla, aut duplo major. Quod si eosdem valores accurate velis determinare, adhibere poteris *Mensuram* eodem *Scholio* definitam, sive $2mAr \times \frac{M+N-4Ar}{\sqrt{L+K-\frac{3}{2}r^2}}$, unde habebis $v = \frac{rV\sqrt{L+K-\frac{3}{2}r^2}}{2M+N-4Ar}$

& $\rho = \sqrt{2} \times \frac{M+N-4Ar}{\sqrt{L+K-\frac{3}{2}r^2}}$. Poteris etiam adhibere series infinitas eodem *Scholio* expositas.

PROBLEMA IV.

Aqua in vacuum effluente ex foramine circulari in medio fundo vasis cylindrici, ubi particule aquæ inter defluendum intra vas tantam patiuntur resistantiam ex defectu lubricitatis, ut inde notabiliter imminuatur Motus aquæ, & data Mensura aquæ effluentis, definire Motum ejusdem, & velocitatem qua per medium foramen egreditur.

Sit data *Mensura* aquæ tempore T effluentis, $2mr^2Aq$. Huic ergo æqualis erit *Mensura* per analysin designata in solutione *Problematis* secundi, nempe

nempe $\frac{2mr^2 Av}{3V}$, hoc est $2mr^2 Aq = \frac{2mr^2 Av}{3V}$,
 five $v = 3Vq$.

Motus vero ejusdem aquæ per analysin defini-
 gnatus in eodem *Problemate*, est $\frac{mr^2 Av^2}{3V}$; & loco
 v^2 substituendo ejus valorem modo inventum, fit is
Motus $\frac{mr^2 A}{3V} \times 9V^2 q^2 = 3q^2 mr^2 AV$. Q. E. I.

COROLL. Si ex *Motu*, qui tempore T ge-
 nerari possit a columna aquæ foramini insistente,
 five ex $mr^2 AV$, detrahatur *Motus* aquæ eodem
 tempore effluentis, $3q^2 mr^2 AV$, relinquitur *Motus*
 tempore T ex resistentia perperditus $mr^2 AV \times 1 - 3q^2$.

SCHOLIUM.

Si accuratam solutionem desideres, recurrendum
 est ad Scholium secundum Probl. II. hunc in mo-
 dum; $2mr^2 Aq = \frac{16mA^2v}{rV} \times \frac{M+N-4Ar}{M+N-4Ar}$, unde

$v = Vq \times \frac{r^3}{8A \times M+N-4Ar}$. Et *Motus*
 aquæ effluentis tempore T , erit $mr^2 AV \times q^2 r^2 \times$
 $\frac{L+K-\frac{3}{2}r^2}{M+N-4Ar}^2$: unde *Motus* ex resistentia perperditus

tempore T , erit $mr^2 AV \times \frac{q^2 r^2 \times L+K-\frac{3}{2}r^2}{M+N-4Ar}^2$.

PROBLEMA V.

Iisdem positis datisque, & negligendo accelerationem aquæ extra foramen, determinare diametrum venæ aqueæ ad parvam distantiam extra foramen, ubi vena maxime contrahitur, & velocitatem aquæ in vena sic contracta.

Per tertium Problema, Mensura aquæ per sectionem venæ transeuntis tempore T est $\frac{2m\varrho^2 Av}{V}$: hæc autem æqualis est Mensuræ datæ $2mr^2 Aq$; unde $\varrho^2 v = r^2 Vq$.

Porro, per idem Problema tertium, Motus aquæ per sectionem venæ transeuntis tempore T , est $\frac{2m\varrho^2 Av^2}{V}$, cui æqualis est Motus superiore problemate definitus, $3q^2 mr^2 AV$, unde $2\varrho^2 v^2 = 3q^2 r^2 V^2$.

$$\text{Est autem } v = \frac{2\varrho^2 v^2}{2\varrho^2 v} = \frac{3q^2 r^2 V^2}{2qr^2 V} = \frac{3qV}{2}.$$

$$\text{Et } \varrho^2 = \frac{r^2 Vq}{v} = r^2 Vq \times \frac{2}{3qV} = \frac{2r^2}{3}; \text{ unde } \varrho = \frac{r\sqrt{2}}{\sqrt{3}}. \text{ Q.E.I.}$$

COROLL. I. Eadem persistat ratio inter radium foraminis & radium venæ contractæ, sive minuatutuncunque per resistantiam Motus aquæ effluentis, ut in hoc Problemate, sive non minuatut, ut in Problemate III. cum sit utrobique $\varrho = \frac{r\sqrt{2}}{\sqrt{3}}$

COROLL. 2. Cum minuitur per resistantiam *Motus* aquæ effluentis, minuitur simul velocitas in vena contracta. Cum enim in *Problemate* tertio fuerat $v = \frac{V\sqrt{3}}{2}$, fit modo $v = \frac{3qV}{2}$, hoc est, minuitur v ex $V \times 0,866$ ad $V \times 0,856$ sumendo $q = 0,571$ ex *Poleni* experimentis.

SCHOLIUM.

Accurate erit $v = V \times r^2 q \times \frac{L + K - \frac{3}{2}r^2}{M + N - 4Ar}^2$,
eritque $q = \sqrt{2} \times \frac{M + N - 4Ar}{\sqrt{L + K - \frac{3}{2}r^2}}$, pariter atque inventum est in *Scholio* secundo *Problematis* tertii.

PROBLEMA VI.

Aqua in aërem effluente per foramen circulare in medio fundo vasis cylindrici, ubi particule aquæ inter defluendum intra vas tantam patiuntur resistantiam ex defectu lubricitatis, ut indenotabiliter minuat Motus aquæ, & data Mensura aquæ effluentis, definire Motum ejusdem, & velocitatem quæ per medium foramen egreditur.

Sit data *Mensura* aquæ tempore T effluentis $2mr^2Aq$, ut in *Problemate* IV. & opo ejusdem *Problematis* habebitur *Motus* ejusdem $3q^2mr^2AV$, & velocitas quacum egreditur per centrum foraminis, sive $v = 3qV$. Q. E. I.

COROLL. Cum datur q , est v ut V , hoc est, ut \sqrt{A} .

SCHOLIUM.

Hæc eadem accurate definita reperies in *Scholio Problematis IV*.

PROBLEMA VII.

Aqua in aërem effluente, negligendo accelerationem aquæ extra foramen ex gravitate ortam, si dentur duæ quælibet ex tribus sequentibus, nempe Mensura aquæ effluentis, velocitate in axe venæ contractæ, & diametro ejusdem venæ, reliquam determinare.

Cum aqua ex foramine erumpens per vacuum fertur, ostensum est in solutione *Problematis III*. æqualem fieri velocitatem particularum aquæ per totam sectionem venæ contractæ: Nunc autem, cum vena per aërem fertur, tollitur necessario æqualitas ista velocitatis. Partes enim venæ exteriores aërem circumjacentem in motum concitant, atque ab eodem ipsæ retardantur, adeo ut parem cum reliquis velocitatem adipisci nequeant. Partes autem extimæ, cum ab aere retardentur, partes contiguas interiores retardant, hæque proximæ; atque eo pacto fit, ut particula quæque interior celerius feratur particula contigua exteriore, adeo ut velocitas maxima sit in axe venæ, in ambitu minima. Et cum partes exteriores tardius ferantur per aërem, quam, sublato aëre, per vacuum ferrentur, inde fit ut partes mediæ velocius

ferantur, aëre venam ambiente, quam ferrentur aëre sublato. Qua de causa mediæ partes aquæ in fontibus salientibus multo altius adsurgunt in aëre aperto, quam in vacuo essent adscensuræ, prout monuimus sub finem *Schol. 1. Probl. III.*

Porro, ex partes acris, quæ venæ aqueæ sunt contiguæ, cum ab aqua in motum concitentur, ipsæ alias sibi extrorsum adjacentes in motum concitant, hæque proximas exteriores, & illæ reliquas successive ad certam aliquam distantiam ab ambitu venæ.

Velocitas autem particularum aquæ ab axe venæ ad ambitum ejusdem ita decreseat, necesse est, ut particulæ cujusque ubicunque sitæ una eademque sit velocitas relativa respectu particulæ extrorsum adjacentis, iisdem ex causis quas exposuimus in solutione *Problematidis* secundi. Nam si quævis particula velocitatem relativam majorem habeat quam reliquæ, ea majorem experietur resistentiam ex attritu particulæ extrorsum adjacentis, & eo pacto ad æqualem cum ceteris velocitatem relativam perducetur. Pari modo particula quæque aeris circumpositi, qui in motum concitatur, unam eandemque habebit velocitatem relativam respectu particulæ aëreæ extrorsum adjacentis.

At longe discrepat velocitas relativa particularum aquearum inter se, a velocitate relativa particularum aeris, quod hoc modo concipi potest.

Particula quævis aquæ in extrema vena constituta, a particula aquæ introrsum proxima sollicitatur ad motum accelerandum; eadem a particula proxima acris retardatur: & cum particula ista extrema justam velocitatem adeptæ sit, pares sint, necesse est, hæ duæ vires contrariæ, quarum altera retardat particulam, altera acce-

accelerat. Id vero fieri non potest, nisi factum ex velocitate relativa & densitate particulæ aqueæ accelerantis, æquale sit facto ex velocitate relativa & densitate particulæ aeræ retardantis. Est autem densitas aeris ad densitatem aquæ, ut 1 ad 900 circiter. Itaque velocitas relativa inter extimam particulam aqueam & proximam aeream, est ad velocitatem relativam inter duas proximas particulas aqueas, ut 900 ad 1 circiter.

Porro, particula ista intima aerea ad motum accelerandum sollicitatur a proximâ contigua particula aquea, retardatur a particula aerea extrorsum proxima. Cumque hic etiam vires duæ contrariæ sibi invicem æquales sint, erit factum ex densitate & velocitate relativa particulæ aqueæ accelerantis, æquale facto ex densitate & velocitate relativa particulæ aeræ retardantis. Unde erit velocitas relativa, quæ est inter duas istas particulas aereas, ad velocitatem relativam, quæ est inter particulam intimam aeream & proximam aqueam, ut 900 ad 1 circiter; eritque eadem ad velocitatem relativam, quæ est inter duas proximas particulas aqueas, ut 900×900 ad 1 fere: & hæc tanta velocitas relativa perpetuo sibi constabit per totam crassitiem annuli aeris, qui ab aqua profluente in motum concitatur.

Designentur jam literis r, m, v, a, V, A, T , eadem atque in secundo Problemate literis iisdem significantur. Esto etiam v velocitas aquæ in axc venæ aqueæ contractæ, ρ radius ejusdem venæ, R radius venæ imaginariæ, per quem velocitas v , decrescendo gradatim, pari modo atque decrescit in vena vera, tandem ad nihilum redigatur.

Sit etiam *Mensura* aquæ tempore T effluentis per foramen, $2 q m r^2 A$.

Jam *Mensura* aquæ eodem tempore fluentis per venam contractam, methodo in *Problemate* II. expofita, invenietur $\frac{2 m A v \rho^2}{3 R V} \times 3 R - 2 \rho$.

Hæ autem *Mensuræ* æquales funt, hoc est,
 $2 q m r^2 A = \frac{2 m A v \rho^2}{3 R V} \times 3 R - 2 \rho$, five, $3 q r^2 R V$
 $= v \rho^2 \times 3 R - 2 \rho$.

Porro, cum *Mensura* aquæ effluentis per foramen tempore T fit $2 q m r^2 A$, *Motus* ejusdem, per *Problema* VI. est $3 q^2 m r^2 A V$.

Et *Motus* aquæ per venam fluentis eodem tempore, per methodum *Problemate* secundo usurpatam, invenitur $\frac{m A v^2 \times 6 R^2 \rho^2 - 8 R \rho^3 + 3 \rho^4}{3 V R^2}$.

Hi autem æquales funt, hoc est, $3 q^2 m r^2 A V =$
 $\frac{m A v^2 \times 6 R^2 \rho^2 - 8 R \rho^3 + 3 \rho^4}{3 V R^2}$, five, $9 q^2 r^2 R^2 V^2 =$
 $v^2 \times 6 R^2 \rho^2 - 8 R \rho^3 + 3 \rho^4$.

Duabus his æquationibus rite reductis ad expungendam R , pervenitur ad æquationem fequentem,
 $\rho^4 v^2 = 2 q v V r^2 \rho^2 + 12 q^2 V^2 r^2 \rho^2 - 9 q^2 V^2 r^4$,
 unde $\rho^2 = \frac{q V r^2}{v^2} \times v + 6 q V - 2 \sqrt{3 q v V + 9 q^2 V^2 - 2 v^2}$,
 & hinc obtinetur ipfe ρ , five radius venæ contractæ, cum dantur q & v .

Porro,

Porro, ex eadem æquatione elicitur, $u = \frac{qVr}{\xi^2} \times$
 $\frac{1}{r + 2\sqrt{3\xi^2 - 2r^2}}.$

Denique, $q = \frac{\xi^2 u}{rV \times r + 2\sqrt{3\xi^2 - 2r^2}}.$ Q.E.I.

SCHOLIUM I.

Supra posuimus *Motum* aquæ per venam contractam fluentis æqualem *Motui* effluentis per foramen. Id autem, si rigorem Mathematicum spectes, non est verum. *Motus* enim aquæ per foramen effluentis aqualis est *Motui* aquæ per venam contractam fluentis, & *Motui* annuli aerei venam ambientis, qui aer ab aqua per venam fluente in motum concitatur, simul sumptis. Sed annuli aerei *Motum*, cum ejus annuli crassities non sit major quam $\frac{R-\xi}{900 \times 900}$, ejusque den-

sitas non sit major parte $\frac{1}{900}$ densitatis aquæ, pro nihilo habemus; idque faciendo æquationes longe simpliciores reddimus quam alioqui essent futuræ.

SCHOLIUM II.

Per *Corollarium* I. *Problematis* V. cum aqua in vacuum effluit, eadem semper perstat ratio inter radium foraminis & radium venæ contractæ, sive minuatur utcunque per resistantiam *Motus* aquæ effluentis, sive non minuatur. Unde, ut in re physica, veri simillimum censemus, datam haberi rationem inter

inter hos radios, etiam cum aqua per aerem profluit, utcunque minuat *Motus* aquæ cffluentis per refiftentiam, aut faltem eam rationem non nifi quam minimum mutari. Idque cum reperiatur contentaneum experimentis hætenus factis, quod infra clarius apparebit, nos pro vero habebimus, donec experimenta in posterum accuratius inftituenda aliquid certius docuerint.

Porro, fi datur ratio inter r & ρ , datur etiam ratio inter r & R , five ratio inter radium foraminis, & radium imaginarium, per quem velocitas v gradatim decrefcendo ad nihilum redigitur.

Nam, eliminando v ex æquationibus duabus fupra pofitis, $9q^2r^2R^2V^2 = \rho^2v^2 \times 6R^2 - 8R\rho + 3\rho^2$, & $3qr^2RV = \rho^2v \times 3R - 2\rho$, pervenitur ad æquationem, $\rho^2 \times 9R^2 - 12R\rho + 4\rho^2 = r^2 \times 6R^2 - 9R\rho + 3\rho^2$, unde $R = \frac{\rho \times 2}{3} + \frac{r}{\sqrt{3\rho^2 - 2r^2}}$.

Præterea, ex altera harum æquationum, $3qr^2RV = \rho^2v \times 3R - 2\rho$, fit $3r^2R : \rho^2 \times 3R - 2\rho :: v : qV$, & cum data fit ratio prior, datur etiam ratio pofterior, hoc eft, datur quantitas $\frac{v}{qV}$.

Quantæ autem fint tres hæ rationes datæ, poftera demonftrabimus.

Reliqua proximo Transactionum Numero communicabimus.

III. *Dias Antrorum mirabilis Naturæ, glacialis alterius, alterius Halitus noxios eructantis, ad Regiam Societatem Scientiarum Londinensem, a Matthia Belio Pannonio, R. S. S. missa.*

CAPUT I.

De Antro Glaciali Szelicensi.

§. I. **E**ST, in *Carpathi* radicibus, qua se in meridiem, jugis dorsisque sensim mitescentibus, sinuant, *Comitatus Thornensis*, ab arce *Thorna*, sic adpellatus. Angusto is ambitu, ac fere montibus impedito, definitur: quos tamen, pro *Carpathi* ingenio, passim naturæ prodigia, insignes faciunt. In his montem suo merito recensueris, qui inter *Szelicze*, & *Borsua*, vicos adtollitur: non quod mole reliquos antecellat, sed quod speciem habeat portentosam, cujus nunc historia exhibenda est.

§. II. *Antrum Szelicense* dicimus, a vico *Szelicze* nuncupatum. Situs pago, inter sylvas ac nemora, collinus ideoque effœtus, cœlum asperum, aër obtigit frigidus, quem validi ac fere perpetui Aquilones, ex nivoso celsoque illo *Carpatho*, a Septentrione dejecti, extra modum immitem reddunt, ut muscis atque culicibus tunc quoque inhospitalis sit, cum tota regione maxime calet. In hujus vici agro, antrum, de quo sermo est, in montem nunc memoratum grandi & obverso in Aquilonem hiatu dehiscit: quippe qui, orgyias XVIII. altus, IX. latus est, atque ideo accipendis ac penitus hauriendis Aquilonibus sic satis ido-

neus laxusque. Profunda antri, & subterranei petrosique specus, inexpertis meatibus, in Meridiem abeunt.

§. III. Natura antri id habet prodigii, quod cum extus bruma intensissime riget, tepido sit intus aere; frigido contra, immo glaciale, cum sunt fervidissimi soles. Nimirum, simul diffugientibus nivibus, verinire coepit, interior antri concameratio, qua ea meridiano soli dorso obicit, aquam limpidam & passim distillantem exsudat: quæ interni frigoris vi, in pelucidam glaciem concrefcens, stirias efficit, ad ingentium doliorum molem crassas ac pendulas, inque ramos abeuntes, miris illusos speciebus. Quod aquæ, e stiriiis, humi arenosæ decedit, id quoque opinione celerius congelat. Ergo, non fornices modo, natura in solidam petram cavati, sed fundum quoque antri, multa & nitida glacie convestitum est. Crederes, totam cavernam, e crystallo, substructam incrustatamque esse, ita circumquaque glacies resplendescit.

§. IV. Inusitatus hic obtutus eo est ingredientibus speciosior, quo antri intercapedo & latius abit, & deprimitur profundius. Qua adiri potest antrum, quinquaginta orgyiarum profundum, sex & viginti laxum est; concamerationum altitudine, ob tuberosos rupium arcus, inæquali. Quod ultra demergitur, propter hiatus præcipitium, inexpertos habet recessus. Neque enim erat adhuc, qui in adcundis antri penetrabilibus facere voluisset periculum, ob lubricos gressus, & fallentem vestigia glaciem. Certe enim, incisis, multo labore, gradibus opus habent, qui vel exploratum profundum illud adire volunt. Erant, qui immissa bolide, specus interiora ibant exploratum: verum, quod antrum, non ad putei modum recto
tramite,

tramite, seu perpendiculariter, deprimitur, sed varie se, & in anfractus sinuat, inutile fuit experimentum. Plus ii profecerunt, qui sclopos, solide largeque fartos, intra specum disploserunt. Adversum est enim, absorptos intime boatus, per plura temporis minuta, ad modum validissimi tonitru, illiso huc & illuc sonitu, horrendum quid reboasse: quod argumento fuit, profunde antrum propagari, habereque diffusos quaquavorsum meatus.

§. V. Glaciale istud specus ingenium, totum æstivum est: quod ideo admirationis habet plurimum; augefcit enim cum increscente solis ardore. Primo, nimirum, vere, hibernus ille tepor cessare, mox, ubi id adolevit, intendi frigus occipit, tantis accessionibus, ut quo magis aër incalcescit, eo antrum frigeat exquisitius. At ubi æstas iniit, jamque fervet Canicula, in glaciale brumam intus abeunt omnia. Tunc scilicet, ubertim destillant ex specus fornicibus aquæ, in glaciem solidantur, tantis incrementis, ut, quæ hodie tenues adparebant stiria, ex perendie dolia referant, & quasi in præceps ruentia petrarum fragmenta. Passim, quæ guttatim per antri latera, demanat latex, mirificæ visuntur incrustationes, & ad tapetum formam, quasi ex artis præscripto, fabrefactæ. Reliquum glaciæ ita mutuo hærescit, prouti æstus sub dio sunt vicissitudines. Nam, si continenter & vehementius calcat, plus glaciæ & stiris adcrefcit, & parietibus fundoque antri; sin calor, quod fit, aut Aquilonibus aut delapsis imbribus temperetur, lentius concrefcunt aquæ, quin & glaciæ ipsa largius tunc sudat, & exiles quasi rivulos quosdam fundere incipit: dum, incalcescente iterum cœlo, ad ingenium redeat, glaciale specus temperamentum. Fuere, qui observârunt, præ-

ſagire ejus naturam aëris viciffitudines, ſicuti ſolent barometra. Nam, ſi aër extus immineat fervidior, pluribus ante horis, quam fervor ille adeſt, tenaciore gelu aquæ adſtringuntur in glaciem: quod contra ſe habet, ſi aer ſub dio ingruat frigidior; tunc enim, calidiſſimo adhuc cœlo, dimanare ſenſim glacies incipit.

§. VI. Fit, ex hac antri natura, ut tantum ei ſufficiat, de pellucidiffima glacie, quantum ne ſexcentæ quidem quadrigæ, in ſingulas hebdomadas oneratae, poſſint exinanire. Atque habent hoc omnino in more poſitum accollæ, ut cum operis campeſtribus diſtinentur, & aut ſœno parando, aut cogendis frugibus, in antri hac vicinia, ſuo ritu, vacant, glaciem hinc promant, eaque aut refrigerent tepentes fontanas, aut ad ſolis æſtum glaciem ipſam in potum liquefaciant: inſigni ſalubritatis opinione; quando putant aquæ iſtud genus & ſtomachum minus onerare, & pronius ſeu per ſudores excerni, ſeu per veſicam: quod proclive eſt omnino ad credendum, in ea aquarum percolatione: qua de re jamjam arguendi erit locus.

§. VII. Sunt vero frigori, intenſiori illi, & remiſſiori, ſuæ per antrum regiones. Ex aprico, jucundus ad ſpecum eſt aditus: quippe auram adflans, Ethęſiarum ſimillimam. Mox, ad paſſus aliquot progreſſis, plus inhorreſcere, ac ſi porro pedem proferant, ſubantque antri propylæon, artus intremiſcere occipiunt, ut neceſſum habeant laxatas forte ſub dio veſtes curatius adſtringere. Inde, in profundum abeuntes frigus excipit brumali ſuppar, ut hi quidem calidiore halitu manus conſovere, illi valida artuum commotione, moleſtum, ac fere intolerabile frigus, mitigare debeant.

Quod

Quod eo subinde fit intensius, quo se profundius immittunt curiosi scrutatores. Sed, gradum referentibus, contraria eveniunt omnia: nam, quo ex imo, pedem efferunt altius, eo frigus est remissius; dum remittat atque intepefcat penitus. Postea, ubi Canicula deferbuit, jamque in autumnum æstas desit externi aëris habitum specus suapte natura sequitur. Primis nimirum mensibus, & dum noctes ineunt gelidiores, dimanare sensim glacies, tunc frigescente magis ac magis aëre, & ubi jam glacie extus rivi adstringuntur, quasi admotis ignibus, liquefcere incipit; donec incumbente bruma, nullo post se relicto vestigio, prorsus inarescat. Tunc vero placidus, toti specui, calor inducitur, fitque glaciale illud conditorium perfugio insectis, & bestiolis aliis hiemem ægre ferentibus. Nam præter muscarum & culicum agmina, vespertilionum item globos, atque noctuarum contubernia, lepores quoque & vulpes hospitatum huc concedunt: dum adolescente vere iterum redeat specui glaciale illud ingenium. Antri superficies, profunda humo obruta, atque soli opposita meridiano, ubere ac pingui gramine herbescit, estque ideo pabulantibus armentis, quin & foeniscoio, si pecus arceatur, opportuna.

§. VIII. Hæc ita se habent. Nunc, quemadmodum insolens antri natura explicanda sit, paucis videamus. Universim, eæ sunt caloris atque frigoris vicissitudines, in subterraneis, ut certare quasi mutuo videntur. Nam, cum æstuat foris aer, frigent cavernarum istiusmodi recessus; atque tepent iterum, cum extus aëre frigus est: id quod, cellæ vinariæ, profundius paulo depressæ, quotidiano & vulgari satis experimento, condocent. Nempe, ea est caloris efficacia, ut, quum telluri, elemento ex se crasso, humido,

ac frigidus, incumbit, nativum ejus frigus interius propulset, atque in factas arte aut natura specus, coactum, notabiliter condenset. Quod aliter se habet, quando frigus terræ superficiei incubat; prolicit enim, imis visceribus, conceptum, a quocunque principio, calorem, & quæ se per cellas aut cavernas diffundere potest, aërem efficit tepidum, passim etiam eximie calentem. Succurrit, hæc scribenti, civium meorum, per Hungariam, campestem illam, & æstivis solibus, extra modum torridam, vini frigefaciendi, vetus consuetudo. Nempe, cum per vastas solitudines iter faciunt, aut illic, pro re nata, moras coguntur necere, neque aut glacies, aut fontana aqua, refrigerando potui sufficit, scrobem, ad duorum fere pedum altitudinem, humi defodiunt: huc demum vinarias lagenas immittunt, atque refossa humo, diligenter ac solide contegunt: tunc ignem subitaneum & luculentum, super eadem illa scrobe, in qua vinum est conditum, ex stramine, foeno aut arundine, componunt; qui ubi suapte restinctus, aut disiectus est consulto, regesta calente extus humo, vinum eximunt, non secus refrigeratum, quam si aquæ glaciali immersum habuissent. Unde vero, vino illi inductum frigus illud? Nimirum, flammæ ille fervor, qui superficiem scrobis subito concalescit, nativum terræ frigus, undiquaque condensatum, lagenæ circumfudit, quod demum vinum pervasit, fecitque gustui idoneum.

§. IX. Pronum hinc est conjicere, quemadmodum antrum istud *Szelizense*, nunc glaciali sit natura, nunc iterum tepescente. Caloris extus, in antri superficiem incumbentis, vis & efficacia, condensato, terræ atque petrarum, quæ subtus in fornices abeunt, nativo frigore, aquas gelidas primum, mox & congelantes,

lantes, efficit: dum refrigerato iterum aëre, prolificatur, imis terræ visceribus conceptus calor. Hæc, ad eum modum, vulgo in sensus incurrunt. Quæ cum adfero, non ideo accedo *Morini* sententiæ, qua apud *du Hamelium*, terram, uti aërem, in tres dispertitur regiones; quarum prima, alternis friget & calet; hieme calida, æstate frigidior, usque ad cccc hexapedas seu orgyias patet. Hanc secunda regio, ejusdem illa opinione, excipit, quam semper fervere, ipse expertum se in fodinis Hungaricis ait. Tertiam, jugi frigore tanquam centro terræ, proximam algere conjectat; quemadmodum media aëris regio perpetuo frigida est, ac suprema, & cœlo finitima, semper calet. Hæc, inquam, *Morino* relinquimus, tanquam inexplorata incertaque. Sane, quæ de fodinis Hungaricis, ad regionis secundæ perpetuum calorem adferendum, memorat, non sunt undiquaque vero consentanea. Nam fodinarum quidem, quas optime cognitas habeo, nulla ad quadringentarum orgyiarum profundum, vix ulla ad ducentas hexapedas, deprimitur, ob erumpentium subtus aquarum impedimenta; qui ergo poterat ferventem perpetuo regionem terræ secundam, demum infra quadringentas hexapedas, incuntem, adire? Sunt fodinis suæ omnino regiones, tepidæ hic, ferventes alibi, etiam iis locis, quorum profundum ne octoginta quidem orgyias conficit. Sed, ad antri glaciali naturam redeamus.

§. X. Multum, ad eam confert, præter vulgarem, quam adtulimus, causam illam, ab incumbentis caloris vi petitam, ipsa antri positio, & concamerationis ingenium. Obversum est nempe ore hiante, frigidissimis Aquilonibus, qui a *Scepusiaco Carpatko*, in has ejus radices immissi, & frequentes sunt, & vernis
po-

potissimum atque æstivis mensibus, ultra modum sæviunt, immo furunt; quodque ex nivosis montibus illis deruunt, vehunt secum gelidissimas particulas, quæ demum in os antri illapsæ, & in ejus concavo, quasi conglomeratæ urgente extus calore, ex facili, destillantem aquam pervadunt, inque glaciem adstringunt. Accedit, habitus concamerationum, quæ totæ e petris, solidissime invicem compactis, & heic submotis altius, alibi in ruinam quasi impendentibus, factæ sunt. Petrarum autem *Carpathi*, plerumque, falsa, nitrosa, aluminosa atque vitriolica est natura. Ergo quid esse potest proclivius, quam glaciem in antro hoc *Szelicensi*, ex glacialium & dictarum particularum commixtione, ubertim progenerari? Adsentientur nobis, qui artificiosam liquorum congelationem, repetitis sæpius experimentis, condidicerunt. Nix enim, vel glacies, cum, sale communi, nitro, aut alumine, aut vitriolo, æqua portione, permixta, & vasi circumposita, aquam vase contentam, in glaciem congelat, etiam media æstate, vel prope ad ignem: ut documenta alia, quæ sunt in promptu, fileamus. Hucusque de antro *Szelicensi*.

CAPUT II.

De Antro Ribariensi, Halitus noxios eructante.

§. I. **L**etales specus, passim, per orbem terrarum observârunt veteres, juxta & nuperi scriptores. Non est instituti mei, eorum, vel nomina tantum conscribere: fuscè, id genus scrobes seu antra, & horum halitus, *Georgius Agricola* prosequitur, Libro IV. de Natura eorum, quæ effluunt e terra.

Do-

Dòesticum Hungariæ antrum, quod est in *Comitatu Zolienfi*, ad vicum *Ribar*, describendum mihi proposui: partim, ut rem omnem ex vero expromerem, partim ut scriptorum detegerem aberrationes. Meminer, antri hujus, laudatus nunc *Agricola*, eodem, quem citavi, loco: *Nec pars Ungariæ*, inquit, *quondam Dacia dicta, libera est a pestilentibus spiraculis: quæ a Neusohla, oppido, æris metallis claro, absunt circiter sex millia passuum, hæc interdum aves, quæ advolârint, & reliquas animantes, quæ accesserint, solent necare.* Male, *Neosolium*, Dacia concludi, suo loco a monui; de pestilentibus spiraculis, quæ accusat *Agricola*, infra dispiciam. Ad eum fere modum, *Wernherus*, ejusdem *Ribarensis* antri meminit^b, quem jam non est opus exscribere: quippe qui, propositum habeam, meas ipsius *ἀνέκδοτα* observationes, paucis recensere.

§. II. *Ribar* vicus est *Comitatus Zolienfis*, sesquimillari, secundo amne *Grano*, Neosolio, in meridiem repressus: quem loco^c nunc citato, memoravimus. In hujus agro, collina in orientem positione, *Thermæ* scatent, exquisitæ quidem salubritatis; sed ingenii admirabilis: quas jam non vacat expromere. A thermarum istis scatebris, sexcentis circiter passibus, ad solem meridianum, specus hæc, obnoxios, quos eructat, halitus, jam pridem infamis, in lætæ valliculæ, exiguo quodam, sed graminoso prato, se adaperit, habetque vicinum fontem acidum, ad potandum, sic

* Notitiæ Hung. Novæ Tomo II. in Historia Comitatus Zolienfis, Parre Gen. Memb. I. §. XII. p. 396.

^b De Admirandis Hung. Aquis; & hunc sequuti, innumeri alii.

^c Tomo II. p. 504. num. 22.

fatis idoneum. Olim, dum incuriosior istiusmodi portentorum ætas fuit, vix erat quisquam, qui animum advertisset, ad scrobis inusitata ingenium. Ergo, sibi quasi relicta, & dumis circumdata, raro, aut nunquam adibatur. Fuit vero tunc, ad fontis modum, aquas ubertim eructantis, comparata, quæ, altius salientes non secus, circumquaque dimanabant, quam id in filanis fieri advertas, ubi aqua ex fusore, in cadum saliens, iterum defluit, dum meatus arte factos, subeat. Aquæ indoles, lapidescens fuit: quippe longo adfluxu, tophum generans, in eam sensim molem, circa os fontis excrecentem, ut collis postea speciem retulerit: quo quidem, tophacei lapidis incremento, ipsa demum scaturigo, adobruta est; quando nequibat latex ad summa fontis labra, sicuti fiebat antea, bulliendo proflire. Accessit, rusticorum, fontis præfocandi studium, ne esset, quod jumentis suis metuerent postea.

§. III. Hic vetus scrobis an fontis habitus fuit, cujus vestigium, adparet hodieque, in meridionale prati latus, ad silvosi collis pedem, reductum. Postea, cum subterraneæ atque uberes aquarum venæ, occultis meatibus, e nupero eo fonte, dimanarent, factum est, ut resolutam humum, proxime ad pristinam illam scaturiginem, subruerent, atque dehiscente prato, novum hiatum aperirent. Hic demum, noxios illos halitus eructare iterum, & cum avibus, tum alii animalium generi, exitialis esse cœpit. Advertere agresles accolæ, non cavernam tantum, fatifcente humo, loco antehac continenti, recenter factum, sed perniciosas etiam ejus exspirationes; quando, nunc aves enectas, nunc prostratas feras, ultimo, pascencia isthic jumenta, subito exanimata, reperiebant.

Dici

Dici nequit, quantis execrationibus invisam specum, rustica plebs, infectata sit: tamquam, quæ ab irato numine, depressa, toti illi agro perniciem, sibi exitium, aut jamjam minaretur, aut portenderet in posterum. Ostenti fama late didita, Avernum hi, Orcum illi, alii, hiatum M. Curtii facinore, expiandum, conclamabant. Dehiscibat vero caverna, ad infundibuli speciem, cujus suprema circum labra, ad calicis modum, laxè & in longum diducta, (erant enim viginti quatuor passuum longa, lata duodecim) in arctum sensim coibant, dum in angustum foramen, imo fundo, desinerent, per quod noxius ille halitus erumperet. Aquarum certe subterlabentium streperum murmur exauditur adhuc, ut pronum sit conjectatû, undosum esse oportere rivum, qui per cæcos istos meatus fertur, hauriturque demum incertis gurgitibus. Neque enim usquam erumpit in apricum, tametsi, prona, in vallem declivitas, modico a scrobe intervallo, ineat.

§. IV. Insolens hoc cavernæ ingenium, uti penitus indagarem, non unam, inde ab Anno MDCCVIII. viam inii. Et primo quidem, cum amico, naturæ curioso, pullum gallinaceum, bene adultum, hastili alligatum, supra os specus ita protendi, ut ferire eum debuerint erumpentes ex imo halitus. Vix vero, hostile, ad specum, cum pullo admoveram, cum miser ille, alas complodere cœpit, momentoque exspiravit. Secuimus enectum ita pullum, ut observaremus quid virulentæ rei fuerit, quod eum tam subito exanimârit? Sed nihil quidquamprehendimus, quam restagnantem in præcordiis sanguinem, ceteroquin ab omni labe alia intemeratum. Tunc, ipse ego, exsecis prius in humo gradibus, in scrobem me immisi, ut micantem intus aquam propius contemplerer; sed

ante pes erat referendus, quam penitus descendissem; eo quod, ex halituum adflatu, & pectus præfocari coepit, & caput tentari vertigine. Illud mirabile visum est, quod vapores cavernæ, & cum maxime noxii sunt adversi, nihil nebulosi aut crassi, quodque notabiliter in oculos incurrisset, referrent: purus ei semper & limpidus aër incubat: quod aliter se habuit in Plutoneo, cujus Strabo atque Plinius meminere. Ergo experiendum rebamur, quid hoc sit expirationum, quod, cum oculis notari haud possit, citam adeo mortem animantibus acceleret. Succurrebat, vix re alia naturam earum explorari posse, quam longiori & capaci fistula, sclopum vocant, pyrio infarta pulvere, intra specus intima, displosa. Id ut factum est, intonuit caverna, & quasi fremitu edito, conceptum interne fumum, pluribus postea horis, jucundo spectaculo, eructabat. Cepimus proinde, ex hoc phænomeno, argumentum, immixtas, displosione illa, in antrum, flammæ, sulphureas intus exhalationes, incendisse, quæ huc & illuc rotatæ, diutius postea in auras exspirabant. Atque fuerunt sane foetoris eximie sulphureosi, prorsus ad eum modum, qualis tempestate ingruente, in thermis observatus a me est: qua de re infra.

§. V. Sulphureo isto halitu observato, facile fuit ad existimandum, quidquid perniciosæ noxæ inest, expirationibus illis, sulphuri id adtribui oportere, volatili ei, & ultra omnem modum subtili. Itaque, dedimus operam, ut haustas ex caverna letifera aquas, firmando experimento, possemus sollicitius adhibere. Incendit eam cupiditatem, avicularum enectarum, & passim circa specum jacentium frequentia: vix enim unquam, seu mane, seu a prandiis, ad orcum hunc acce-

accedebamus, quin nova reperiremus funera. Inprimis, Erinaceus, nos adtentos fecit; qui eodem cacoëthe suffocatus, unius noctis intervallo, adeo intumuit, ut distenta cute, spinæ simul, firmissime alioquin hærescentes, radicibus elisæ conspicerentur: quod quidem suspicandi locum præbuit, annon forte bestiola, non halitus tantum cavernæ imbiberit, sed & aquas ipsas, quæ interne inagno nifu ebulliunt, & eodem iterum hiaru, ocu gurgite quodam, absorbentur denuo. Pulmones certe erinacei, livido colore tincti, quin & viscera reliqua, ultra solitam molem distenta, indicio fuerunt, & laticem gustasse, & halitus noxios penitus bibisse bestiam, jam tum, grave quid ac molestum, redolentem. Proinde, aquam, ex profundo eo cavernæ gurgite haurimus; haud, sine famuli, quem pronum in caput, sed funibus religatum, immiseramus, periculo. Fuit ea limpидitate plusquam crystallina, levis adhæc, & quasi ætherea, odoris modice sulphureosi, saporis acidiusculi quidem & modice acris, sed haud tamen, seu linguam, seu palatum adrodentis. Nempe, ad ingenium acidularum, quas vicinas habet caverna, proxime sunt visæ accedere. Timidius primum, laticem suspectum, & extremis tantum labris gustabamus, dum, alter alterius exemplo factus audentior, modicos primum haustus, mox largiores etiam, nihil dubitarem facere. Neque cuiquam, tametsi plerique nostrum, delicatioris, & ex thermarum usu, etiam fastidiosi fuerint ventriculi, noxia fuit ea curiositas; quin erant, qui aqua ea, vinum Hungaricum, generosum illud, miscere posse optarent.

§. VI. Ista sic, & ex vero, plurium annorum curis adhibitis observavimus; ut ferri hinc possit iudicium, rectene, ab *Agricola*, & *Wernhero*, pestilentes specus hujatis.

hujatis expirationes, adpellentur. Nuperus scriptor, virus omne, vel a terræ putredine, vel a stagnantis nescio cujus humoris, vitiositate, provenire, audaciter existimat: quas opiniones singulas, jam excutiamus. Et primo quidem, tametsi letales sint cavernæ hujus halitus, pestilentes certe non sunt: quippe qui, non ob congenitum, & quod secum veherent, virus enecant animantia; sed ex causis aliis, quas mox indicabimus. Enimvero, si pestilenciales essent expirationes illæ, aquæ bibi, multo minus, enectæ halitibus istis animalculâ, uti sunt galli gallinacci, turdi, palumbes, ac lepusculi comedi, sine vitæ, saltem melioris valetudinis jactura, possent: quod faciunt tamen procul omni noxa, qui rei inusitatæ faciunt experimentum, dum in thermis hujatibus, aut animi aut salubritatis causâ, lavant. Sed terræ forte putredo, aut stagnantis cujusvis humoris vitium, exitiales illos ructus expirant. At horum profecto neutrum est. Nam, si hoc admittas; halitus cavernæ crassos, atque nebulosos; aquam contra turbidam & molestum quiddam sapientem esse oportebit: quam tamen limpida, saporis adhæc, non putridi, sed subacidi; vapores præterea, ita comparatos esse diximus, ut oculis cerni observarique haud possint. Ergo a subtilissimi copia sulphuris, & mineralium admixtis halitibus, qui per subterraneos eos meatus, una cum aquis, præcipiti ac strepero lapsu feruntur, expirationum earum letalis noxietas arcessi debet: non quod suapte natura sint exitiales; sed quod nimia illa subtilitas, completis subito pulmonum bronchiis, præclusoque necessario ad respirandum aëre, adeoque præfocato illic sanguine, ictu oculi, & ante enecent animantia, quam id existimari potest. Qui aliter de re tota sentiunt, & ipsi errant,

errant, & in errorem inducunt alios; cavernæ autem infamiam conflant, nulla alia ratione expungendam, quam si hac nostra observatione, ad erroris confessionem, inducti, palinodiam cecinerint.

§. VII. Ceteroquin, de sulphureo isthoc expirationum cavernæ nostræ ingenio, & inde capi potest indicium, quod thermæ adsitæ, ejusdem sint naturæ; tamenli crassiorum halituum, & qui, nunc sunt intensiores, nunc remissiores iterum: quemadmodum scilicet, coeli ærisque habitus est, quo in calidas illas, singularis prorsus esse consuevit influxus. Nempe, si fervente aëre, in tempestatem pronum sit cœlum, thermæ nunquam non sulphur redolentes, ultra omnem modum sulphureosum quid foetere incipiunt, fiuntque lavantibus non molestæ tantum, sed etiam intolerabiles, immo letales; tunc maxime, cum, aquis per emissarium ex lavacro subductis, recentes iterum ebulliunt. Vidi equidem, virum robustum ac militarem ætate adhuc firma, cum ingruente, horis post-meridianis, graviore tempestate, in thermas lavaturus se immisisset, sustinuissetque aliquantisper sulphureos, qui tunc ex more invaluerunt, halitus, lymphato similem, ex lavacro profiliisse, conceptaque inde febris acuta, quadriduo post, mortem suam obiisse. Nescio autem, etiamne, tempestatum his vicissitudinibus caverna, de qua agimus, sit obnoxia: neque enim, quod dolendum, ita fui curiosus, ut & hoc momentum, reliquis experimentis, curatius, sicuti meruit, adjunxissem. Illud constat, cœlo etiam sudo, & cum nulla in aëre est tempestatis suspicio, variare halituum noxiam efficacitatem illam; & nunc celerius enecare admota animalcula, nunc iterum lentius: quandoque cessare penitus, & quasi ingenium suum deferere: in
cujus

cujus tamen rei causas, neque ipse ego indagavi, neque memini, amicos unquam indagavisse. Jam, ita sarmentis cavernam obruerunt accolæ, ut vix adiri possit amplius. Quin & avicularum funera rariora sunt hodie, quam fuerunt olim: quod equidem profundius, quam antea, manantibus aquis adtribuerim. Hæc de his, hætenus.

IV. *An Account of a very extraordinary Tumour in the Knee of a Person, whose Leg was taken off by Mr. Jer. Peirce, Surgeon at Bath; communicated in a Letter to Dr. Mead, Physician to His MAJESTY, and Fellow of the College of Physicians, and of the Royal Society, London.*

S I R,

Bath, June 11. 1737.

AS no one has been more conversant with the surprizing Disorders to which Men are liable, or takes a greater Pleasure in their Relief, than yourself, so I flatter myself the following Case cannot fail of being acceptable to you.

William Hedges of Stratton in Somersetshire, a Farmer's Son, of 25 Years of Age, of a muscular healthy Habit, having never known any kind of Disease; about eight Years since first observed a small Swelling on his Right Leg near the superior Epiphysis of the Tibia, which (to use his own Terms) he called a Splint, about the Bigness of a split Horse-bean. As he was not conscious of any Bruise on the Part, and

as it was wholly free from Pain, so the only Reason he had to regard it, was from its constant Increase, which during the two first Years was very slow; but afterwards it increas'd so fast (though without Pain) as to render him altogether incapable of Labour from the time of Hay-Harvest 1735.—

Upon taking off the Limb in *May* last, I found it weighed, with the Leg and Foot, Sixty-nine Pounds, which (to the best of my Remembrance) is Twenty-seven more than the Leg some Years since taken off at *St. Bartholomew's* Hospital by Mr. *Gay*, for the like Disorder. The Operation itself afforded nothing uncommon, except the Quantity of recurrent Blood, which, however greater than usual, seem'd proportional to the increased Bulk of the Part.

Upon examining this surprising Tumour, the adjacent Muscles were found destitute of their fibrous and fleshy Appearance (probably from the Pressure, and great Extension, which they had suffer'd, and the little Motion which for some Years they had employ'd upon the *Tarsus* and Toes); but the *Fascia* and common Membranes of the Muscles, being greatly thickened and callous, adhered to the subjacent Tumour; and upon removing this callous Integument, the Tumour appear'd cover'd with great Quantities of Blood-vessels, much distended, and of a Colour more intensely red than natural.—

The Tumour itself was Cartilaginous for the Space of half an Inch from its external Surface; from whence it form'd numberless bony Substances of various Forms, Colours, and Consistences, which (growing more and more numerous, as they lay deeper) at last form'd a continual Substance com-
H pletely

pletely ossify'd: In the Centre of this bony Substance we found about a Quart of mucilaginous Liquor, no ways fetid, (though it was then ten Days from the Operation) whose Colour and Consistence nearly resembled that of *Linseed Oil*; in which we observ'd many little bony Substances loose and floating, similar to many others adhering to the internal Surface of the Cavity, all which had nearly the Appearance of those irregular Incrustations, which in hollow Rocks are sometimes made by the dropping of petrifying Waters. After the Operation, every Circumstance of the Cure proceeded as I could wish, and the Stump is now healed.

It seems well worth observing, that the Parts above the Tumour were very little alter'd from their natural State. The Cartilaginous Extremity of the *Femur* was perfectly smooth; nor had the *Rotula* suffer'd any other Injury except the Ossification of the Ligament by which it is fixed to the *Tibia*; but the superior Extremity of the *Fibula* was wholly lost in the Tumour.

May we not justly admire the Goodness of a Constitution, which could bear such enormous Extensions in the Integuments, the Tendinous *Fascia*, and even the Bone itself, without Pain and Inflammation? Or can we sufficiently wonder, that the Fluids should be so little disposed to putrify, as to bear so great a Diminution in their Motion, and for so long Time, without vitiating the Constitution, or tainting even the Parts affected? Herewith (Sir) I beg your Acceptance of two Portraits of this surprising Case (See T A B. II.): The first Figure represents the Limb immediately after the Operation; the 2^d Figure shews the

the Tumour as opened : In both the Artift has fo far employed his Care and Skill, as well in preferving the juft Dimensions as in the Colours and Appearances, that I am left only to wifh, that in the Defcription, which I have made, my Pen had not fallen fhort of his Pencil.—I am, with the greateft Refpect,

S I R,

*Your moft obliged
humble Servant,*

Jer. Peirce.

V. *An Experiment concerning the Spirit of Coals, being part of a Letter to the Hon. Rob. Boyle, Esq; from the late Rev. John Clayton, D. D. communicated by the Right Rev. Father in God Robert Lord Bifhop of Corke to the Right Hon. John Earl of Egmont, F. R. S.*

— **H**AVING feen a Ditch within two Miles from *Wigan* in *Lancashire*, wherein the Water would feemingly burn like Brandy, the Flame of which was fo fierce, that feveral Strangers have boiled Eggs over it ; the Pople thereabouts indeed affirm, that about 30 Years ago it would have boiled a Piece of Beef ; and that whereas much Rain formerly made it burn much fiercer, now after Rain it would fcarce burn at all. It was after a long-con-

tinued Season of Rain that I came to see the Place, and make some Experiments, and found accordingly, that a lighted Paper, though it were waved all over the Ditch, the Water would not take Fire. I then hired a Person to make a Dam in the Ditch, and fling out the Water, in order to try whether the Steam which arose from the Ditch would then take Fire, but found it would not. I still, however, pursued my Experiment, and made him dig deeper; and when he had dug about the Depth of half a Yard, we found a shelly Coal, and the Candle being then put down into the Hole, the Air caught Fire, and continued burning.

I observed that there had formerly been Coal-pits in the same Close of Ground; and I then got some Coal from one of the Pits nearest thereunto, which I distilled in a Retort in an open Fire. At first there came over only *Phlegm*, afterwards a black *Oil*, and then likewise a *Spirit* arose, which I could noways condense, but it forced my Lute, or broke my Glasses. Once, when it had forced the Lute, coming close thereto, in order to try to repair it, I observed that the Spirit which issued out caught Fire at the Flame of the Candle, and continued burning with Violence as it issued out, in a Stream, which I blew out, and lighted again, alternately, for several times. I then had a Mind to try if I could save any of this Spirit, in order to which I took a turbinated Receiver, and putting a Candle to the Pipe of the Receiver whilst the Spirit arose, I observed that it caught Flame, and continued burning at the End of the Pipe, though you could not discern what fed the Flame: I then blew it out, and lighted it again several times; after which

which I fixed a Bladder, squeezed and void of Air, to the Pipe of the Receiver. The *Oil* and *Phlegm* descended into the Receiver, but the Spirit, still ascending, blew up the Bladder. I then filled a good many Bladders therewith, and might have filled an inconceivable Number more; for the Spirit continued to rise for several Hours, and filled the Bladders almost as fast as a Man could have blown them with his Mouth; and yet the Quantity of Coals I distilled were inconsiderable.

I kept this Spirit in the Bladders a considerable time, and endeavour'd several ways to condense it, but in vain. And when I had a Mind to divert Strangers or Friends, I have frequently taken one of these Bladders, and pricking a Hole therein with a Pin, and compressing gently the Bladder near the Flame of a Candle till it once took Fire, it would then continue flaming till all the Spirit was compressed out of the Bladder; which was the more surprising, because no one could discern any Difference in the Appearance between these Bladders and those which are filled with common Air.

But then I found, that this Spirit must be kept in good thick Bladders, as in those of an Ox, or the like; for if I filled Calves Bladders therewith, it would lose its Inflammability in 24 Hours, though the Bladder became not relax at all.

VI. *An Experiment concerning the nitrous Particles in the Air ; by the same Hand.*

— I Took a small Gally-pot, such as the Apothecaries in the North of *England* make use of, where I was when I made this Experiment, and ground the Top of it very smooth and true, and adapted thereto a Cover of blue Slate, which I had likewise ground with much Care. Into this Gally-pot I put equal Quantities of Nitre and Flour of Sulphur, about a Drachm of each. I then fixed on the Cover, putting it into a new Digester ; but the Height which I raised the Heat to, and how long I continued it, I do not exactly remember, but believe it was three or four Seconds. When I opened it the Day following, I perceived something had transpired betwixt the Top of the Gally-pot and the Cover ; the top Edges of the Gally-pot, where the Glazing was ground off, being discolour'd, though the Nitre and Sulphur were very little diminished as to their Weight ; only they were melted into one Lump, which I took out of the Gally-pot.

And having set the empty Gally-pot upon a Shelf, upon looking at it the next Day, I found long hoary Hairs, very bright and brittle, all around the ground Edges of the Pot, very specious to behold. After I had admired them a while, I gathered them, and, tasting them, found them to be pure Nitre. I then set the Pot upon the Shelf again, and in three or four Days, still finding there were fresh Shoots made, as large and specious as at the first, I gathered them a second and third time ; so that I suppose the
Pot

Pot would have continued to have shot fresh Nitre much longer, if I had not had urgent Use for it, to make other Experiments in. However, it is to be observed, that I had already gathered more Nitre than I put into the Pot at first; though, as I said before, for what I could perceive, I had taken all or near all the Nitre that I first put in together with the Sulphur, out of the Pot in a Lump. Hence we may have some Conceptions of the Nature of mineral Earths, and how they grow and increase, when once impregnated with the Seeds of a Mineral. This likewise is a Proof of the Quantity of nitrous Particles with which the Air abounds, since the large Quantity of Nitre which I collected out of the Pot, when left empty upon the Shelf, could be supplied by the Air only.

N. B. These three Experiments are all that I could save intire out of a great Number which were sent to the Hon. Mr. Boyle, in Answer to a Letter from him to Mr. John Clayton, containing 17 *Quære's*.

ROBERT CORKE.

VII. *Extract of a Letter from John Ratty, M. D. to Dr. Mortimer, Secr. R. S. concerning the Poison of Laurel-Water.*

Dear Doctor,

Dublin, May 17. 1732.

I Received thine of Feb. 15. with the *Transactions* N^o 418 and 420. giving an Account of the Experiments upon *Laurel-Water*. I wish your Experiments

ments with the Milk, had more fully determin'd and ascertain'd it to be an Antidote, than they have yet done. I am informed by Dr. ——— that some Apothecaries in *England*, being us'd to sophisticate *Black-Cherry-Water* with *Laurel-Leaves*, will not be persuaded, that this is a Poison on human Bodies, notwithstanding our few Instances. I can now confirm that it really is so by this Story, which thou mayst be assured of the Truth of.

At *Lisiminy* in *Westmeath*, a Girl of 18 Years old, very well and healthy, took a Quantity, less than two Spoonfuls, of the first Runnings of the *Simple Water of Laurel-Leaves*; whereupon within half a Minute she fell down, was convulsed, foamed at the Mouth, and died in a short time, nor was there any Swelling on her Body.

Printed for T. WOODWARD, at the *Half-Moon*, between the *Two Temple-Gates* in *Fleetstreet*; and C. DAVIS, the Corner of *Pater-noster-row*, next *Warwick-lane*; PRINTERS to the ROYAL SOCIETY. M.DCC.XLII.

N. B. The *Philosophical Transactions* being three Years behind-hand in regard of Time, we shall skip over 10 Numbers, and commence the *Transactions* for the current Year 1742. and the XLIII^d Volume with N^o 462. and so continue to publish the Papers for the future in the precise Order of the Times of their being read before the *Royal Society*; in the mean time this XLII^d Volume, or the *Transactions* from N^o 452. to 462. shall be filled up with all possible Speed.

PHILOSOPHICAL TRANSACTIONS.

For the Months of *April, May and June, 1739.*

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- II. *A Collection of the Observations of the Eclipse of the Sun, August 4th 1738. which were sent to the Royal Society.*
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I. *Tentaminis de Mensura & Motu aquarum fluentium, præcedente Transactionum Numero communicati, pars reliqua; Auctore Jacobo Jurin, M. D. Soc. Reg. & Colleg. Medic. Londinens. Sodale.*

De Resistencia partium aquæ inter se, ex defectu lubricitatis oriunda.

Priusquam ulterius progrediamur, expendenda est ea *Resistencia* fluidorum, quæ oritur ex motu partium eorundem inter se, quamque *Newtono* auctore vocamus *Resistentiam* ex defectu lubricitatis oriundam.

Hanc ille duplicem statuit, alteram quæ oritur ex tenacitate fluidi, alteram quæ fit attritu, seu affrictu mutuo partium fluidi inter se.

Priorem, data superficie, uniformem esse censet, seu effectum edere tempori proportionalem; & favent experimenta: posteriorem opinatur augeri in ratione velocitatis, vel ratione paulo minori. Sed de hac nihil diserte statuit, cum desint idonea experimenta.

Diversam autem rationem inter se invicem obtinent hæ duæ *Resistentiæ*, non solum pro diversitate fluidi, quum oleo, ex. gr. aut sevo liquefacto major insit tenacitas quam aquæ, minor attritus; sed etiam in fluido eodem, pro diversa velocitate qua moventur partes fluidi inter se. In dato autem fluido datur necessario certa aliqua velocitas, ubi pares inter se invicem sint hæ *resistentiæ*; & si istam velocitatem experimento reperire liceret, posset in aliis quibuscunque velocitatibus earundem proportio determinari. Experimenta vero nulla habemus, quod sciam, nec facile est ulla excogitare, quorum ope cognosci queat ista velocitas, quæ cæteris pro fundamento inservire possit.

Susplicamur quidem, immo pro verisimili habemus non una de causa, quamminimam in aqua esse velocitatem istam fundamentalem, ubi resistentiæ ex tenacitate & ex affricu oriundæ æquales sunt inter se. Hoc autem concessio, cum crescente velocitate crescat pariter resistentia ex affricu, nullatenus vero crescat resistentia ex tenacitate, pater ultimam hanc resistentiam non nisi parvam admodum rationem obtinere ad priorem, ubi partes fluidi notabili aliqua velocitate moventur inter se; & proinde tuto negligi posse.

Cæterum, siue hac neglecta, alteram solam resistentiam, quæ ex affricu oritur, siue utramque comprehendere oporteat nomine *Resistentiæ* ex defectu lubricitatis oriundæ, leges certe, quibus crescat aut minuat hanc *Resistentia*, non nisi ab experientia sunt petendæ. Sequentes itaque crescendi leges cum ei tribuimus, etsi post diligentem experimentorum hactenus factorum considerationem, magnam veri similitudinem habere videantur, id tamen eo animo facimus, ut si quid certius docuerint experimenta in posterum instituenda, sententiam non inviti mutemus.

HYPOTHESIS.

Resistentia, quæ oritur ex defectu lubricitatis aquæ, est in ratione composita ex tribus sequentibus:

1. Ex ratione superficiæ partium quæ moventur. Hoc, puto, admittunt omnes Philosophi.

2. Ex ratione velocitatis relativæ, qua moventur partes aquæ inter se. Hoc a reliquis, ni fallor, admittitur, nec multum dissentit *Newtonus*.

3. Ex ratione subduplicata altitudinis aquæ. Id nos adsumimus, duce experientia, & aliquatenus etiam auctore

auctore *Newtono*, qui cenſet majori preſſione fieri attritum partium fortiorem, & ſeparationem ab invicem difficiliorem. *Princip. Lib. II. Prop. LII. Schol.*

PROBLEMA VIII.

Exponere reſiſtentiam partium Cataractæ, quæ oritur ex defectu lubricitatis.

Sit r radius foraminis, A altitudo Cataractæ, y radius cujuſlibet ſectionis horizontalis, x altitudo Cataractæ ſupra iſtam ſectionem, z radius circuli cujuſvis in iſta ſectione, v velocitas aquæ in centro foraminis.

Erit modo $\frac{v x^{\frac{1}{2}}}{A^{\frac{1}{2}}}$ velocitas aquæ in centro ſectionis, cui radius y . Nam velocitas in centro ſectionis eadem eſt ac ſi ſectio iſta eſſet foramen in fundo vaſis decurtati, cui altitudo x ; adeoque eſt ut $x^{\frac{1}{2}}$ per Corollarium Probl. VI. Erit etiam $\frac{y-z}{y} \times \frac{v x^{\frac{1}{2}}}{A^{\frac{1}{2}}}$ velocitas aquæ in circumferentia circuli, cui radius z ; $\frac{z v x^{\frac{1}{2}}}{y A^{\frac{1}{2}}}$ velocitas relativa; $2 m z x$ ſuperficies cylindri naſcentis, cui radius z , altitudo x ; eritque per tres noſtras poſitiones, *Reſiſtentia* ſuperficiæ hujus cylindri, ut $2 m z x \times \frac{z v x^{\frac{1}{2}}}{y A^{\frac{1}{2}}} \times x^{\frac{1}{2}} = \frac{2 m v x x z z}{y A^{\frac{1}{2}}}$.

Conſiderentur jam x , x , & y ut quantitates conſtantes, dum fluit z uſque donec evadit æqualis ipſi y ; &

& erit fluxionis $\frac{2m\dot{v}\dot{x}\dot{x}z^2}{yA^{\frac{1}{2}}}$, quantitas fluens
 $\frac{2m\dot{v}\dot{x}\dot{x}z^2}{2yA^{\frac{1}{2}}}$, five $\frac{m\dot{v}\dot{x}\dot{x}z^2}{yA^{\frac{1}{2}}}$, five, (ponendo $z=y$)
 $\frac{m\dot{v}\dot{x}\dot{x}y}{A^{\frac{1}{2}}}$, ut resistentia cylindri nascentis, cui radius
 y , altitudo x .

Sed per proprietatem curvæ *Cataracticæ*, $y^4x=r^4A$,
 & $yx^{\frac{1}{4}}=rA^{\frac{1}{4}}$: unde *Resistentia* cylindri hujus na-
 scentis erit ut $\frac{m\dot{v}\dot{x}\dot{x}rA^{\frac{1}{4}}}{A^{\frac{1}{2}}x^{\frac{1}{4}}}$, five ut $\frac{m\dot{v}\dot{r}\dot{x}x^{\frac{3}{4}}}{A^{\frac{1}{4}}}$; &
Resistentia totius *Cataractæ* erit ut hujus fluxionis
 quantitas fluens, five ut $\frac{m\dot{v}\dot{r}\dot{x}x^{\frac{7}{4}}}{A^{\frac{1}{4}}}\times\frac{4}{7}$, five, ponendo
 $x=A$, ut $\frac{4}{7}m\dot{v}\dot{r}A^{\frac{3}{2}}$. Et cum per *Problema* IV.
 fit $\dot{v}=\frac{3}{2}qV$, erit *Resistentia* in *Cataracta*, ut
 $\frac{12qmV\dot{r}A^{\frac{3}{2}}}{7}$, five ut $qVrA^{\frac{3}{2}}$. Q.E.I.

COROLL. Cum sit V ut \sqrt{A} , erit *Resistentia* in
Cataracta, ut qrA^2 .

SCHOLIUM.

In solutione modo exposita, pro superficie taleolæ
Cataracticæ, cui radius z , secundum quam particulæ
 aqueæ se mutuo præterfluunt velocitate relativa æqua-
 bili, adhibuimus superficiem cylindri nascentis, cui
 radius z , altitudo x , five superficiem $2mzx$, cum
 revera ejus taleolæ superficies sit $2mz\times\sqrt{x^2+z^2}$.

Id autem si corrigatur, invenietur *Resistentia* superficiei hujus talcolæ ut $2mz\sqrt{x^2+z^2} \times x^{\frac{1}{2}} \times \frac{zvx^{\frac{1}{2}}}{yA^{\frac{1}{2}}}$

$$= \frac{2mvxz\sqrt{x^2+z^2}}{yA^{\frac{1}{2}}}.$$

Cumque, per *Scholium 2. Problematis II.* subtangens curvæ *Cataracticæ* sit $4x$, & tangens ipsa $\sqrt{16x^2+z^2}$, erit $4x:\sqrt{16x^2+z^2}::x:\sqrt{x^2+z^2}$

$$= \frac{x\sqrt{16x^2+z^2}}{4x}.$$

Itaque *Resistentia* superficiei talcolæ erit ut

$$\frac{2mvxz}{yA^{\frac{1}{2}}} \times \frac{x}{4x} \sqrt{16x^2+z^2} = \frac{mvx}{2yA^{\frac{1}{2}}} z \sqrt{16x^2+z^2}$$

$$= \frac{mvxz}{2yA^{\frac{1}{2}}} \text{ in } 4x + \frac{z^2}{2 \times 4x} - \frac{z^4}{8 \times 4x^3} + \frac{z^6}{16 \times 4x^5}$$

$$- \frac{5z^8}{128 \times 4x^7} + \frac{7z^{10}}{256 \times 4x^9} \text{ \&c. } = \frac{mvx}{2yA^{\frac{1}{2}}} \text{ in } 4xz$$

$$+ \frac{z^3}{2 \times 4x} - \frac{z^5}{8 \times 4x^3} + \frac{z^7}{16 \times 4x^5} - \frac{5z^9}{128 \times 4x^7}$$

$$+ \frac{7z^{11}}{256 \times 4x^9} - \frac{21z^{13}}{1024 \times 4x^{11}} \text{ \&c. }$$

Habendo autem quantitates x, x , & y pro constantibus, hujus fluxionis fluens erit, $\frac{mvx}{2yA^{\frac{1}{2}}} \text{ in } \frac{4xz^2}{2}$

$$+ \frac{z^4}{8 \times 4x} - \frac{z^6}{48 \times 4x^3} + \frac{z^8}{8 \times 16 \times 4x^5} - \frac{z^{10}}{256 \times 4x^7}$$

$$+ \frac{7z^{12}}{12 \times 256 \times 4x^9} - \text{\&c.}$$

Et

Et ponendo $z=y$, erit hæc fluens $\frac{m v x}{2 A^{\frac{1}{2}}}$ in $2 x y$

$$+ \frac{y^3}{8 \times 4 x} - \frac{y^5}{48 \times 4 x^3} + \frac{y^7}{8 \times 16 \times 4 x^5} - \frac{y^9}{256 \times 4 x^7} \\ + \frac{7 y^{11}}{12 \times 256 \times 4 x^9} - \&c. \text{ quæ erit ut } \textit{Resistentia} \text{ in}$$

taleola Cataractica, cui radius y , altitudo x .

Hæc autem est ut fluxio *Resistentiæ* in tota *Cataracta*,

& ponendo $y = \frac{r A^{\frac{1}{4}}}{x^{\frac{1}{4}}}$, fit $\frac{m v x}{2 A^{\frac{1}{2}}}$ in $\frac{2 r x A^{\frac{1}{4}}}{x^{\frac{1}{4}}}$

$$+ \frac{r^3 A^{\frac{3}{4}}}{8 \times 4 \times x^{\frac{7}{4}}} - \frac{r^5 A^{\frac{5}{4}}}{48 \times 4^3 \times x^{\frac{17}{4}}} + \frac{r^7 A^{\frac{7}{4}}}{8 \times 16 \times 4^5 \times x^{\frac{27}{4}}} \\ - \frac{r^9 A^{\frac{9}{4}}}{256 \times 4^7 \times x^{\frac{37}{4}}} + \&c. = \frac{m v r}{2 A^{\frac{1}{4}}} \text{ in } 2 x^{\frac{7}{4}} + \frac{r^2 A^{\frac{1}{2}} x^{\frac{3}{4}}}{32} \\ - \frac{r^4 A^{\frac{3}{2}} x^{\frac{1}{4}}}{48 \times 4^3} + \frac{r^6 A^{\frac{5}{2}} x^{-\frac{3}{4}}}{8 \times 16 \times 4^5} - \&c. \text{ Hujus autem fluxi-}$$

$$\text{onis quantitas fluens est } \frac{m v r}{2 A^{\frac{1}{4}}} \text{ in } 2 x^{\frac{7}{4}} \times \frac{4}{7} + \frac{r^2 A^{\frac{1}{2}} x^{\frac{3}{4}}}{32} \times -\frac{4}{3} \\ - \frac{r^4 A^{\frac{3}{2}} x^{\frac{1}{4}}}{48 \times 4^3} \times -\frac{4}{13} + \frac{r^6 A^{\frac{5}{2}} x^{-\frac{3}{4}}}{8 \times 16 \times 4^5} \times -\frac{4}{23} - \&c. \text{ Hæc au-}$$

$$\text{tem, ponendo } x=A, \text{ fit } \frac{m v r}{2} \text{ in } \frac{8 A^{\frac{3}{2}}}{7} - \frac{r^2}{3 \times 8 A^{\frac{1}{2}}}$$

$$+ \frac{r^4}{12 \times 13 \times 4^3 A^{\frac{5}{2}}} - \frac{r^6}{32 \times 23 \times 4^5 A^{\frac{7}{2}}} + \&c. \text{ sive,} \\ \frac{4 m v r A^{\frac{3}{2}}}{7} \text{ in } 1 - \frac{7 r^2}{3 \times 4^3 A^2} + \frac{7 r^4}{6 \times 13 \times 4^5 A^4} - \frac{7 r^6}{23 \times 4^7 A^6} + \\ \&c. \text{ quæ est ut } \textit{Resistentia} \text{ per totam } \textit{Cataractam}.$$

Quod si altitudo pro infinita habeatur respectu diametri foraminis, erit *Resistentia* ut $\frac{4mvrA^{\frac{3}{2}}}{7}$, prorsus uti definitum est in solutione priori.

Si $A=10r$, *Resistentia* erit ut $\frac{4mvrA^{\frac{3}{2}}}{7} \times 1 - \frac{1}{2743}$ circiter.

Si $A=4r$, *Resistentia* erit ut $\frac{4mvrA^{\frac{3}{2}}}{7} \times 1 - \frac{1}{439}$ circiter.

Potest itaque usurpari $\frac{4mvrA^{\frac{3}{2}}}{7}$ pro mensura *Resistentiæ*, absque periculo sensibilis erroris, etiam ubi altitudo aquæ non superat duas diametros foraminis, & multo magis in altitudine longe majori.

PROBLEMA IX.

Data Mensura aquæ effluentis per datum foramen circulare in medio fundo vasis cylindrici datæ altitudinis, definire Mensuram aquæ effluentis ex alio vase cujuscunque altitudinis datæ per foramen circulare quodcunque datum.

Sit r radius foraminis dati, A altitudo data, $2qmr^2A$ data *Mensura* aquæ effluentis illo tempore, quo casurum in vacuo sit corpus grave per altitudinem A .

Hinc erit, per *Problema* IV. $3q^2mr^2AV$ *Motus* aquæ eodem tempore effluentis: critique, per *Corollarium Problematis* IV. *Motus* eodem tempore per *Resistentiam* deperditus, $mr^2AV \times 1 - 3q^2$. Hunc itaque
Motum

Motum vis æqualis *Resistentiæ* generare potest eodem tempore.

Sunt autem *Motus* eodem temporis spatio generati viribus eisdem generantibus proportionales.

Itaque *Motus* $mr^2 AV$, quem hoc tempore generare potest, per *Problema* I. pondus columnæ aquæ $mr^2 A$, cum abest omnis *Resistentia*, est ad *Motum* $mr^2 AV \times \sqrt{1 - 3q^2}$, quem eodem tempore generare potest *Resistentia*, ut pondus $mr^2 A$, ad ipsam *Resistentiam*. Unde *Resistentia* $= mr^2 A \times \frac{mr^2 AV \times \sqrt{1 - 3q^2}}{mr^2 AV}$
 $= mr^2 A \times \sqrt{1 - 3q^2}$.

Eodem modo, ponendo s & E pro radio foraminis, & altitudine novi vasis, & $2pm^2 E$ pro *Mensura* aquæ effluentis eodem tempore, quo casurum sit in vacuo corpus grave per altitudinem E , habebis *Resistentiam* in novo vase $= ms^2 E \times \sqrt{1 - 3p^2}$.

Sed per *Corollarium Problematis* VIII. sunt ad invicem hæ duæ *Resistentiæ* ut qrA^2 ad psE^2 .

Itaque, $mr^2 A \times \sqrt{1 - 3q^2} : ms^2 E \times \sqrt{1 - 3p^2} :: qrA^2 : psE^2$, sive $r \times \sqrt{1 - 3q^2} : s \times \sqrt{1 - 3p^2} :: qA : pE$, sive $prE \times \sqrt{1 - 3q^2} = qsA \times \sqrt{1 - 3p^2}$, qua æquatione rite reducta pervenitur ad sequentem,

$$p = \sqrt{\frac{1}{3} + \frac{rE \times \sqrt{1 - 3q^2}}{6qsA}} - \frac{rE \times \sqrt{1 - 3q^2}}{6qsA},$$

vel ponendo $rE = ns'A$,

$$p = \sqrt{\frac{1}{3} + \frac{n \times \sqrt{1 - 3q^2}}{6q}} - \frac{n \times \sqrt{1 - 3q^2}}{6q}$$

Unde

Unde habetur $p \times 2 m s^2 E$, quæ est *Mensura* aquæ effluentis ex secundo vase, quo tempore cadit in vacuo corpus grave per altitudinem E . Q. E. I.

COROLL. 1. Si diametri foraminum fuerint in ratione altitudinum aquæ, eadem erit ratio *Mensurarum*, ac si aqua efflueret sine ulla *Resistentia*.

Nam, si $r : s :: A : E$, $r E = s A$, & $n = 1$, unde

$\sqrt{\frac{1}{3} + \frac{1-3q^2}{6q}} \min. \frac{1-3q^2}{6q}$, & per reductionem $p = q$; unde $2 q m r^2 A : 2 p m s^2 E :: 2 m r^2 A : 2 m s^2 E$, quæ est ratio *Mensurarum*, cum abest omnis *Resistentia*.

COROLL. 2. Si E pro nihilo habeatur respectu altitudinis A , habenda est etiam n pro nihilo, unde fit $p = \frac{1}{\sqrt{3}}$. Itaque, quo minor capitur altitudo E , eo propius vergit p ad $\frac{1}{\sqrt{3}}$.

COROLL. 3. Si s pro infinite magno habeatur respectu radii r , fit $p = \frac{1}{\sqrt{3}}$. Itaque quo major capitur radius s , eo magis vergit p ad $\frac{1}{\sqrt{3}}$.

PROBLEMA X.

Aqua in aërem effluente determinare rationem inter diametrum foraminis & diametrum venæ contractæ.

Hæc ratio sine experimentorum ope determinari nequit. Est equidem, per *Problemæ VII*,

$$g^2 = \frac{qVr^2}{v^2} \times v + 6qV - 2\sqrt{3}qvV + 9q^2V^2 - 2v^2,$$

unde cognitis q & v definitur g .

Sed nulla, quod sciam, habemus experimenta, quibus utramque harum quantitatum q & v metiamur.

Poleni siquidem experimenta *Mensuram* aquæ effluentis exhibent, unde cognoscitur q ; sed distantiam maximam, ad quam fertur aqua ex foramine horizontaliter profiliens, sive distantiam, ad quam pergit media pars venæ, quæ velocitate v exilit, non designant.

Mariotti vero experimenta altitudinem maximam perpendicularem, ad quam profilit aqua motu sursum verso, sive altitudinem, quam attingit aqua ex media vena profiliens, metiuntur, unde cognoscitur v^2 ; sed non exhibent *Mensuram* aquæ effluentis.

Deficientibus itaque idoneis experimentis, vix licebit rationem eam, quam quærimus, nisi præterpropter determinare. Id autem fiet in modum sequentem.

In *Scholio 2. Problematis VII*, verisimile esse docuimus constantem esse rationem inter hos radios, aut saltem non nisi quamminimum mutari.

Constat autem ex *Mariotti* experimentis discrimen inter altitudinem, quam attingit aqua sursum exiliens, & altitudinem vasis, rationem obtinere duplicatam circiter ipsius altitudinis vasis.

Itaque, si a sit altitudo, ad quam motu sursum verso salire possit aqua fluens per axem venæ cum velocitate v ; erit ex *Mariotti* experimentis, $A-a$ ut A^2 ,

& erit $\frac{A^2}{A-a}$ data quantitas.

Sed in uno experimento, quod pro fundamentali habet *Mariottus*, fuit $A = 60$ digit. Parisiensi. & inventa est $a = 59$ digit. Parisiensi. diametro foraminis metiente digitum dimidium. Fuit itaque in hoc casu

$$\frac{A^2}{A-a} = 3600, \text{ cumque data sit hæc quantitas, erit}$$

$$\text{semper } 3600a = 3600A - A^2, \text{ vel } a = \frac{3600A - A^2}{3600}$$

$$= A - \frac{A^2}{3600}.$$

Ergo, si sit $A = 1$ dig. sive dupla diametri foraminis, erit $a = 1 - \frac{1}{3600}$. Sed $v^2 : V^2 :: a : A :: 1 - \frac{1}{3600} : 1$.

Itaque, cum altitudo vasis dupla est diametri foraminis, haberi potest $v^2 = V^2$, vel $v = V$.

Porro, per *Coroll. 4. Probl. IX.* decreſcente E , vergit p ad $\frac{1}{\sqrt{3}}$.

Itaque, cum fit altitudo vasis valde parva, velut si non superet duas diametros foraminis, haberi potest

$$p \text{ vel } q = \frac{1}{\sqrt{3}}.$$

Sed, per *Problema VII*,

$$p^2 = \frac{qVr^2}{v^2} \times v + 6qV - 2\sqrt{3}qvV + 9q^2V^2 - 2v^2,$$

& pro v & q substituendo valores eorundem modo inventos, sive V & $\frac{1}{\sqrt{3}}$, fit

$$p^2 = \frac{r^2}{V\sqrt{3}} \times V + 2V\sqrt{3} - 2\sqrt{V^2\sqrt{3}} + 3V^2 - 2V^2$$

$$= \frac{r^2}{\sqrt{3}} \times 1 + 2\sqrt{3} - 2\sqrt{1+\sqrt{3}}, \text{ five}$$

$$\varrho^2 = r^2 \times 2 + \frac{1}{\sqrt{3}} - 2\sqrt{1+\sqrt{3}} = r^2 \times 0,6687553907$$

unde $\varrho = r \times 0,81777466$.

Hic itaque est valor ipsius ϱ , cum altitudo aquæ dupla est diametri foraminis; & cum per *Scholium 2. Problematis VII.* ϱ constantem obtineat rationem ad radium foraminis, obtinebit eundem valorem in quacunque altitudine aquæ. Q. E. I.

COROLL. I. Per *Problema VII.*

$$R = \frac{\varrho}{3} \times \frac{\sqrt{\varrho^2 + r^2}}{\sqrt{3}\varrho^2 - 2r^2}, \text{ \& ex modo invento va-}$$

lore ipsius ϱ , habetur $R = r \times 3,98877150$, qui est valor ipsius R , cum altitudo aquæ dupla est diametri foraminis; cumque per *Scholium 2. ejusdem Problematis*, constans habeatur ratio inter r & R , obtinebit R hunc ipsum valorem, quæcunque fuerit altitudo aquæ.

COROLL. II. Quoniam v est fere æqualis ipsi V , & q est fere $= \frac{1}{\sqrt{3}}$, ubi altitudo aquæ dupla est diametri foraminis; erit ad hanc altitudinem aquæ, $\frac{v}{qV} = \sqrt{3}$ quamproxime. Et cum, per *Scholium 2. Problematis VII.*, constans sit ratio inter v & qV , erit $\frac{v}{qV} = \sqrt{3}$, quæcunque fuerit aquæ altitudo.

PROBLEMA XI.

Aqua ex dato vase semper pleno per datum foramen in aërem effluente, & data una quavis ex tribus quantitatibus sequentibus, nempe Mensura aquæ effluentis, velocitate in axe venæ contractæ, aut altitudine, ad quam motu sursum verso salire possit media pars venæ, reliquas duas determinare.

Sit A altitudo vasis, r radius foraminis, $2 q m r^2 A$ Mensura aquæ effluentis, v velocitas in axe venæ contractæ, a altitudo, ad quam salire queat aqua effluens per axem venæ, & detur primo $2 q m r^2 A$, unde datur q .

Per Corollarium 2. Problematis X. $\frac{v}{q V} = \sqrt{3}$, unde $v = q V \sqrt{3}$. Hinc $v^2 = 3 q^2 V^2$. Sed $V^2 : v^2 :: A : a = \frac{v^2 A}{V^2} = \frac{3 q^2 V^2 A}{V^2} = 3 q^2 A$.

Si secundo detur v , erit $q = \frac{v}{V \sqrt{3}}$, &

$$2 q m r^2 A = \frac{2 m r^2 A v}{V \sqrt{3}}.$$

$$\text{Porro } a = \frac{v^2 A}{V^2}.$$

Postremo, si detur a , cum sit $a = 3 q^2 A$, erit $q^2 = \frac{a}{3 A}$,

$$\& q = \sqrt{\frac{a}{3 A}}.$$

$$\text{Item } v^2 = \frac{a V^2}{A}, \text{ unde } v = V \sqrt{\frac{a}{A}}. \text{ Q.E.D.}$$

PROBLEMA XII.

Data altitudine, ad quam motu sursum verso salit aqua per aërem erumpens ex vase altitudinis datae per datum foramen circulare, definire altitudinem, ad quam aqua motu sursum verso ascensura sit, cum erumpit ex vase cujuscunque altitudinis datae per foramen circulare quodcunque datum.

Significentur literis, r, s, A, E, q, p , res eadem atque in *Problemate IX*; sintque a & e altitudines, ad quas salire queat aqua erumpens ex vasis, quibus altitudines A & E respective.

Erit jam, per *Problema XI*, $a = 3 q^2 A$, $e = 3 p^2 E$, unde $3 q^2 = \frac{a}{A}$, $1 - 3 q^2 = \frac{A-a}{A}$, $q = \sqrt{\frac{a}{3A}}$, $p = \sqrt{\frac{e}{3E}}$, & $p^2 = \frac{e}{3E}$.

Cumque, per *Problema IX*, sit

$$p = \sqrt{\frac{1}{3} + \frac{rE \times 1 - 3q^2}{6qsA}} = \frac{rE \times 1 - 3q^2}{6qsA}, \text{ vel}$$

$$\text{ponendo } rE = nsA, p = \sqrt{\frac{1}{3} + \frac{n \times 1 - 3q^2}{6q}} = \frac{n \times 1 - 3q^2}{6q};$$

hinc substituendo $\frac{A-a}{A}$ pro $1 - 3q^2$, & $\sqrt{\frac{a}{3A}}$ pro q , ac pro $A-a$ scribendo α , evadet

$$p = \frac{\sqrt{4Aa + n^2\alpha^2} - n\alpha}{2\sqrt{3Aa}}, \text{ \&}$$

$$p^2 = \frac{2Aa + n^2\alpha^2 - n\alpha\sqrt{4Aa + n^2\alpha^2}}{6Aa}.$$

Sed

Sed $p^2 = \frac{e}{3E}$, unde $\frac{e}{E} = \frac{2Aa + n^2\alpha^2 - n\alpha\sqrt{4Aa + n^2\alpha^2}}{2Aa}$,

sive $e = E \times \frac{2Aa + n^2\alpha^2 - n\alpha\sqrt{4Aa + n^2\alpha^2}}{2Aa}$, unde

scribendo ε pro $E - e$, fit $\varepsilon = \frac{nE\alpha}{2Aa} \times \sqrt{4Aa + n^2\alpha^2} - n\alpha$.

Data autem ε , sive $E - e$, datur e , sive altitudo ad quam aqua fertur, cum ex novo vase erumpit. Q. E. I.

COROLL. 1. Si æqualia fuerint foramina in utroque vase, seu $s = r$, erit $E = nA$, vel $n = \frac{E}{A}$ unde $\varepsilon = \frac{n^2\alpha}{2a} \times \sqrt{4Aa + n^2\alpha^2} - n\alpha$.

COROLL. 2. Si æquales fuerint vasorum altitudines, seu $E = A$, erit $r = ns$, seu $n = \frac{r}{s}$, unde

$$\varepsilon = \frac{n\alpha}{2a} \times \sqrt{4Aa + n^2\alpha^2} - n\alpha$$

COROLL. 3. Si diametri foraminum fuerint in ratione altitudinum, salient aquæ ad altitudines ipsis vasorum altitudinibus proportionales. Nam, si $r : s ::$

$$A : E, rE = sA, \& n = 1, \text{ unde } \varepsilon = \frac{E\alpha}{A}, \text{ seu}$$

$$\varepsilon : \alpha :: E : A, \text{ vel } E - e : A - a :: E : A, \text{ sive}$$

$$e : a :: E : A.$$

COROLL. 4. Cum sit $p \times 2\sqrt{3Aa} = \sqrt{4Aa + n^2\alpha^2} - n\alpha$, erit $\varepsilon = \frac{nE\alpha}{2Aa} \times 2p\sqrt{3Aa} = \frac{pnE\alpha\sqrt{3}}{\sqrt{Aa}}$, unde pro \sqrt{a}

substituendo ejus valorem suprapositum, $q\sqrt{3A}$, & reductione debita, fit $\varepsilon = \frac{pnE\alpha}{qA}$, sive $\varepsilon = \frac{prE^2\alpha}{qsA^2}$.

COROLL.

COROLL. 5. Hinc autem ponendo $p=q$, $\varepsilon = \frac{rE^2\alpha}{sA^2}$,
 five $\varepsilon : \alpha :: rE^2 : sA^2$. Hoc est, defectus altitudinum aquarum salientium, five discrimina inter altitudines salientium, & altitudines vasorum, sunt in ratione composita ex ratione duplicata altitudinum vasorum directæ, & ratione diametrorum foraminum reciproci. Hæc autem regula accuratè vera est, ubi $sA=rE$, per *Coroll. 1. Probl. IX*; & proxime ad verum accedit, ubi E & s in eadem circiter ratione augentur, vel minuuntur; nec nisi paulum aberrat a vera aquæ salientis altitudine in quocunque casu, modo E non sit major pedibus 50, & eodem tempore s non sit minor lineis 3.

COROLL. 6. Ubi $s=r$, $\varepsilon = \frac{E^2\alpha}{A^2}$ circiter, hoc est, ubi paria sunt foramina, defectus altitudinum aquarum salientium sunt fere in ratione duplicata altitudinum vasorum, quæ est ipsa *Mariotti* regula.

COROLL. 7. Ubi $E=A$, $\varepsilon = \frac{r\alpha}{s}$ circiter, hoc est, ubi pares sunt altitudines vasorum, defectus aquarum salientium sunt fere ut diametri foraminum reciproci.

SCHOLIUM GENERALE I.

Theoriæ supratraditæ fidem si quis experimentis instituendis explorare voluerit, ei auctor sim,

I. Vase uti amplissimo, saltem in parte superiori, eum in finem ut toto tempore, quo capitur experimentum, altitudo aquæ ad sensum non mutetur.

Quod

Quod si vas ita amplum non sit, quin durante effluxu ex foramine decrementum altitudinis aquæ notatu dignum reperiatur, habenda est pro constanti altitudine altitudo debita intermedia inter maximam & minimam aquæ altitudinem; quod fieri præstat, quam motum aquæ naturalem perturbare affundendo desuper aquam novam.

2. Vasis altitudo tanta sit, ut si aquam per foramen in latere factum emittere velis, velocitas aquæ per centrum foraminis exituræ tuto haberi possit pro velocitate quacum aqua per totum foramen exitura sit, cum abest omnis resistentia.

3. Lamina, in quo sit foramen, tam tenuis sit, aut saltem acie tam tenui in ambitu foraminis, ut ejus aciei crassities pro nihilo haberi possit respectu diametri foraminis. Debet autem recidi crassities laminæ facie externa, relicta plana facie interiore proxime aquam: & angulum hujus aciei tam acutum esse oportet, ut aqua per foramen effluens lateri exteriori laminæ non adhærescat.

His paratis sequentia institui poterunt experimenta, quibus quasi totidem criteriis de certitudine doctrinæ suprapositæ dijudicari queat.

EXPERIMENTUM I. Cum aqua per foramen in latere vasis emittitur, mensuretur diligentissime diameter venæ contractæ, notando utrum semper sibi constet mutata utcunque altitudine aquæ.

EXPER. 2. Observetur etiam utrum hæc diameter eandem semper obtineat rationem ad diametrum foraminis, cum foramina diversæ magnitudinis usurpantur.

EXPER. 3. Aqua effluente vel recta deorsum per fundum vasis, vel horizontaliter per latus ejusdem,

observeretur accuratissime quantum effluat dato tempore, adhibendo diversas altitudines aquæ, sed unum idemque foramen.

EXPER. 4. Idem observeretur, cum foramina diversæ magnitudinis usurpantur, sed eadem adhibetur altitudo aquæ.

EXPER. 5. Observandum quantum effluat dato tempore in casibus duobus diversis, quorum in utroque eadem sit ratio diametri foraminis ad altitudinem aquæ. Nam si *Mensura* reperientur in ratione composita ex ratione duplicata diametrorum, & ratione simplici altitudinum, ut in *Coroll. 3. Problematis IX*, magnam habebis Theoriæ nostræ confirmationem.

EXPER. 6. In iisdem duobus casibus, motu aquæ sursum verso ope tubi ampli lateri vasis adaptati, & superiori parte foramine pertusi, observeretur ad quantas altitudines aqua salit. Nam si reperientur hæ altitudines proportionales altitudinibus aquæ in vase, ut in *Corollario 3. Problematis XII*, habebis alteram hujus Theoriæ certissimam confirmationem.

EXPER. 7. Eodem manente foramine, sed mutata utcumque altitudine aquæ, observandum ad quantam altitudinem feratur aqua.

EXPER. 8. Idem observeretur, cum eadem persistente altitudine aquæ mutatur foraminis magnitudo.

Cæterum, ex omnibus his experimentis præferenda sunt ea, quibus motu aquæ sursum verso notatur altitudo ad quam aqua salit. Hæc enim altitudo & facilius longe capi potest, quam *Mensura* aquæ effluentis, & error, si quis forte admittatur in capienda altitudine, longe minoris est momenti, quam qui admittitur in *Mensura* æstimanda. Cum enim, per
Pro-

Problema XI, altitudo aquæ salientis sit $3q^2 A$, patet, quod error minimus admissus in *Mensura*, five in q , duplicabitur fere in q^2 , adeoque duplicabitur in altitudine aquæ salientis.

At minimus error admissus in altitudine aquæ salientis, five in $3q^2 A$, redigitur fere ad dimidium in æstimanda q , hoc est, in *Mensura* aquæ effluentis.

SCHOLIUM GENERALE II.

Interim, dum ab iis, quibus otium non minus quam veri cognoscendi studium suppetit, fiant aliquando ista experimenta, utendum, quantum fieri potest, iis experimentis quæ nobis suppeditavit antecessorum diligentia.

Hæc autem sunt triplicia. Nam metiuntur vel,

1. Diametrum venæ contractæ; vel,
2. *Mensuram* aquæ effluentis; vel,
3. Altitudinem ad quam aqua salit.

1. Venæ contractæ radius mensurante *Newtono* est $r \times 0,84$, cum diameter foraminis est $\frac{5}{8}$ digiti *Londonensis*.

Idem *Poleno* dimetiente est $r \times 0,78$ circiter, cum diameter foraminis est digitorum *Parisiensium* $2\frac{1}{2}$.

Per calculum nostrum est $r \times 0,818$ fere, quæcunque fuerit diameter foraminis. Quæ magnitudo est intermedia circiter inter mensuram *Newtonianam* & *Polenianam*.

2. Perincommode accidit, ut *Mensuræ* aquæ effluentis ab omnibus capta, præter unum *Polenum*, ad propositum nostrum penitus sint inutiles. Nam docente viro illo eximio, hæc *Mensura*, cum per tubum exit aqua, longe major est quam cum exit ex nudo

foramine. Et cum foramina in laminis facta pro tubis brevibus habenda sint, faltem nisi laminæ crassities quamminima sit respectu diametri foraminis, inde factum est, ut omnes *Mensuræ* aquæ effluentis ante illum captæ majores veris invenirentur.

Utendum ergo solis *Mensuris* a *Poleno* captis. Hæ^a autem, quæ quidem magno illo foramine 26 linearum captæ fuerunt, sunt numero decem, nempe ponendo corpus grave cadere in vacuo per pedes Parisienses 15, digitum 1, lineas 2, tempore minuti secundi, evadit *Mensura*

1 ^a	= 2 m r ² A	× 0,5772
2 ^a	.	0,5772
3 ^a	.	0,5731
4 ^a	.	0,5710
5 ^a	.	0,5690
6 ^a	.	0,5675
7 ^a	.	0,5689
8 ^a	.	0,5703
9 ^a	.	0,5732
10 ^a	.	0,5613
		<hr/>
		5,7087

Quarum omnium intermedia est 2 m r² A × 0,571 fere. Hanc itaque habemus pro *Mensura Poleniana* aquæ effluentis, cum vasis altitudo est digitorum 33 *Parisiensium*, quæ est altitudo intermedia inter eas quæ *Poleno* fuerunt usurpatæ.

Mensura autem, quæ ad hanc altitudinem calculo nostro elicitur ex fundamentali *Mariotti* experimento, quod mox proponemus, est 2 m r² A × 0,5768; quæ parte circiter nonagesima octava superat *Mensuram Polenianam*. Tantulum vero discrimen oriri potuit vel ex errore centesimæ partis digiti in æstimanda dia-

^a Polenus de Castellis, art. 35, 38, 39, 42, 43. & Epistol. ad Mari-
nonium.

metro foraminis; vel ex eo, quod vas excipiens aquam effluentem, centesima circiter parte majus esset quam pro computo *Poleni*; vel partim ex utroque. Adde, quod duplo minus est hoc discrimen, quam quantum reperitur inter ipsa experimenta *Poleniana*.

3. Supra docuimus inutilia reddidisse *Polenum* omnia antecessorum experimenta de *Mensura* aquæ effluentis, quod in iis instituendis nulla habita fuisset ratio crassitiei laminæ, per cujus foramen aqua efflueret. Unde possit aliquis non absurde suspicari, laborare pari vitio etiam illa experimenta, quibus exploratum fuerat ad quantam altitudinem aquæ salirent. Sed dubitationem istam altera egregia observatione sustulit *Polenus*. Is siquidem deprehendit *Mensuram* quidem aquæ longe majorem ex tubo, quam ex nudo foramine effluere; at, quod mireris, quodque nos forsitan, si modo Deus vitam & otium concesserit, aliquando explicabimus, aquam effluentem per tubos 7^a vel 13 lineas Parisienses longos, non nisi ad eandem, aut etiam tantillo minorem profilire distantiam horizontalem, quam attingit aqua ex nudo foramine exiliens. Tantillo itaque minor est velocitas maxima aquæ post exitum e tubo, quam post exitum e foramine, cum tubus non admodum brevis est: sed cum tubus est brevissimus, qualis est foramen etiam in lamina non admodum tenui, eadem haberi potest velocitas maxima aquæ post exitum ex hoc tubo, atque post exitum ex foramine in lamina tenuissima.

Itaque, ad explorandam Theoriæ nostræ certitudinem, licet æque nobis uti experimentis *Mariotti* de

altitudine fontium salientium, atque si foramina, quibus is usus est, in laminis tenuissimis facta fuissent.

Adsumamus ergo ex ejus experimentis unum ali- quod, quod pro fundamento habeatur, ad altitudi- nem in reliquis experimentis per *Problema* nostrum XII indagandam.

Is quidem pro experimento fundamentali proponit istud, ubi altitudo aquæ in vase est præcise pedum 5 *Parisiensium*. At cum tantillus error, puta duarum linearum, in hoc experimento, errorem satis gran- dem, nempe plusquam 8 digitorum, gignat in alti- tudine septies majori, quali postea utitur *Mariottus*; nos illud experimentum pro fundamentali habere ma- lumus, in quo maxima illa adhibetur altitudo septies major priori.

Sit itaque nobis pro fundamento examinis institu- endi experimentum id *Mariotti*, ubi diameter forami- nis est linearum *Parisiensium* 6, & altitudo aquæ in vase est pedum *Parisiensium* 34, digitorum $11\frac{1}{2}$, sive digitorum $419\frac{1}{2}$.

Hanc ille cum altitudinem adhiberet, reperit aquam ex foramine exilientem adsurgere ad altitu- dinem pedum 31 digitorum 8 vel 9, hoc est, ad alti- tudinem digitorum $380\frac{3}{4}$.

Est itaque $A=419,5$. $a=380,5$. & $\alpha=39$ dig.

In altero experimento, ubi *E*, seu altitudo aquæ in vase est pedum 26 digiti 1, salit aqua per idem foramen teste *Mariotto* ad altitudinem pedum 24 digitorum $2\frac{1}{2}$. Prodit vero *e*, seu altitudo aquæ sali- entis, per *Corollarium* 1. *Problematis* XII, pedum 24, digitorum 3.

Cæterum, quo melius conferantur altitudines, quas attingere aquam salientemprehendit *Mariottus*, cum altitudinibus iis, ad quas salire debuerit ex calculo nostro, utrasque coniecimus in Tabellam I; ubi vides ita convenire calculo cum observatis, ut vix quicquam possit supra. Cumque capta sint hæc experimenta eodem foramine diametro sex linearum, altitudine sola mutata, vix potest dubitari, quin tertia nostra positio, qua *Resistentia, cæteris paribus*, est in ratione subduplicata altitudinis, recte se habeat.

TABELLA I.

Diameter foraminis 6 linearum.

Altitudo aquæ in vase	Altitudo salientis aquæ	
	Ex Mariotto	Ex calculo
ped. dig.	ped. dig.	ped. dig.
34. 11,5	31. 8,5	31. 8,5
26. 1	24. 2,5	24. 3
24. 5	22. 10	22. 10
12. 4	12. 0	11. 11
5. 6	5. 4,75	5. 5
5.	4. 11	4. 11. 2 lin.
35. 5	32. 0	32. 1

TABELLA II.

Diameter foraminis 4 linearum.

ped. dig.	ped. dig.	ped. dig.
34. 11,5	30. 0	30. 0
24. 5	22. 8,5	21. 11
5. 6	5. 4,7	5. 4,4

TABELLA III.

Diameter foraminis 3 linearum.

ped. dig.	ped. dig.	ped. dig.
34. 11,5	28. 0	28. 0
26. 1	22.	22. 1
24. 5	22. 2	20. 11
5. 6	5. 4,7	5. 3,7

Cum loco foraminis linearum sex uteretur *Mariottus* foramine linearum quatuor, reperit aquam profilientem ex vase altitudinis supra demonstratæ, pedum 34 digit. $11\frac{1}{2}$, attingere altitudinem pedum 30. Salire debuit per *Corollarium* 2. *Problematis* XII ad pedes 30. digitos $2\frac{1}{2}$ fere.

Postea cum uteretur foramine linearum trium, aqua profilens ex eodem vase attingit altitudinem pedum 28. Profilire debuit per idem *Corollarium* ad pedes 28, digitos 9 circiter.

Sed hæc discrimina inter altitudines ex calculo prodeuntes & eas quas observavit *Mariottus*, ex parvo errore in capiendis foraminum tantulorum diametris oriri potuerunt.

Nam si radius maximi foraminis, quem lineis tribus æqualem statuit *Mariottus*, tres lineas superaverit parte $\frac{1}{100}$ digiti *Parisiensis*; vel si radius secundi foraminis, quem lineis duabus æqualem facit *Mariottus*, parte $\frac{1}{136}$ digiti *Parisiensis* a duabus lineis defecerit; in alterutro casu saliet aqua per calculum ad altitudinem 30 pedum, prorsus uti observavit *Mariottus*.

Item, si radius minimi foraminis, parte $\frac{1}{100}$ digiti *Parisiensis* minor fuerit linea $1\frac{1}{2}$; & simul radius maximi foraminis parte $\frac{1}{100}$ digiti superet tres lineas; dabit

dabit calculus altitudinem aquæ salientis pedum 28 $\frac{1}{2}$ quantam deprehendit *Mariottus*.

Calculo autem ad hunc modum correcto, exhibent Tabellæ 2^a & 3^a altitudines *Mariotti* cum calculo nostro collatas.

Hic autem notandum est, in Tabella II. altitudinem salientis ex vase alto pedes 24. digitos 5. *Mariotto* observatam, nempe altitudinem pedum 22. dig. 8 $\frac{1}{2}$, item in Tab. III. altitudinem salientis ex eodem vase, nempe altitudinem ped. 22. digit. 2. altitudines, quas exhibet calculus noster, magno intervallo superare.

Sed corruptos esse *Mariotti* numeros satis constat. Nam,

1. Regula *Mariottiana* supratradita, cui satis bene convenire cum observatis ipse testatur, numeros multo minores, & satis ad calculum nostrum accedentes exhibet.

2. Fieri omnino nequit, ut aqua saliens ex foramine 4 linearum attingat altitudinem ped. 22. dig. 8 $\frac{1}{2}$; neque ut aqua saliens ex foramine trium linearum attingat altitudinem pedum 22. dig. 2; si quidem aqua saliens ex foramine 6 linearum non attingat nisi altitudinem ped. 22. dig. 10. quod ex analogia observationum *Mariotti* facile patebit.

3. Si vera sit altitudo ped. 22. dig. 2. in Tab. III. salit aqua erumpens ex vase alto ped. 24. dig. 5. ad majorem altitudinem, quam ubi erumpit ex vase alto ped. 26. dig. 1. quod manifeste absurdum est.

His causis adducor ut credam *Mariottum*, ubi de priori ex his experimentis verba faceret, in adversariis suis scriptum reliquisse, *Le jet de quatre lignes n'a été plus bas que d' onze pouces ou onze pouces &*

M

demi,

demī, *que celui dont l'ajutage étoit de six lignes*; unde transcripserit *De la Hirius, plus bas que d'un pouce ou un pouce & demi*. Facta autem hac correctione erit altitudo *Mariotto* observata 21 pedum, & digitorum 11. vel $10\frac{1}{2}$, quæ cum calculo nostro adamussim convenit.

In secundo experimento, cum erumpit aqua ex foramine tres lineas amplo, patet ex analogia salire aquam debere ad altitudinem duobus circiter pedibus minorem, quam ubi erumpit ex foramine sex linearum. Forte, loco verborum *celui de trois lignes a été plus bas que celui de six lignes* de pres de 8 pouces, scriptum fuerat *Mariotto*, plus bas que celui de six lignes *d'un pied & 8 pouces*, quod non longè distat a calculo nostro.

Id vero mirum non videbitur, ejusmodi errata contingere potuisse, si animadverteris ipsum Cl. *De la Hirium*, qui, post obitum *Mariotti*, ejus chartas imprimendas curaverit, in præfatione huic operi præfixa hæc habere. *La moitié de cet ouvrage étoit assez au net pour être imprimée: mais le reste m'a donné beaucoup de peine à rassembler sur les Memoires qui m'en ont été mis entre les mains après sa mort.*

Cæterum, omnibus perpensis, adeo bene convenit calculo nostro cum experimentis clarissimi hujus & diligentissimi observatoris, ut etiam cum *Mensura Poleniana* aquæ effluentis, cumque menturis diametri venæ contractæ *Newtono* & *Poleno* captis, ut vix dubitandum sit quin aut vera, aut vero quamproxima sit supra exposita theoria.

Hæc autem facile extenditur ad aquam effluentem per foramen quadratum, aut rectangulare quodvis,
vel

vel etiam ad foramen annulare, quale ambit circellum Newtonianum Corollariis ultimis *Prop.* XXXVI. *Libr.* II. *Princip.* adhibitum, unde in Resistentia fluidorum continuorum ex hujus circelli contemplatione deducta plura videntur mutanda; quod in antecessum eruditos monere visum est, quo eos ad accuratius præcedentium examen excitarem.

II. *A Collection of the Observations of the Eclipse of the Sun, August 4th 1738. which were sent to the Royal Society.*

- I. *An Eclipse of the Sun, observed August the 4th 1738. by Mr. George Graham and Mr. Short, FF. R. S. at Mr. Graham's House in Fleetstreet, London, by a Refracting Telescope of 12 Feet Focus, armed with a Micrometer, and by a reflecting Telescope of nine Inches focal Length.*

	h.	'	"
Beginning of the Eclipse at	9.	59.	20 A. M.
End at	11.	59.	36
Quantity of Obscuration by }	dig.	min.	
the Micrometer . . . }	3.	28.	
	h.	'	"
Duration	2.	0.	16

N. B. The Person who was observing the Transit of the Sun over the Meridian, observed the End to be at the same Instant with the above Observation.

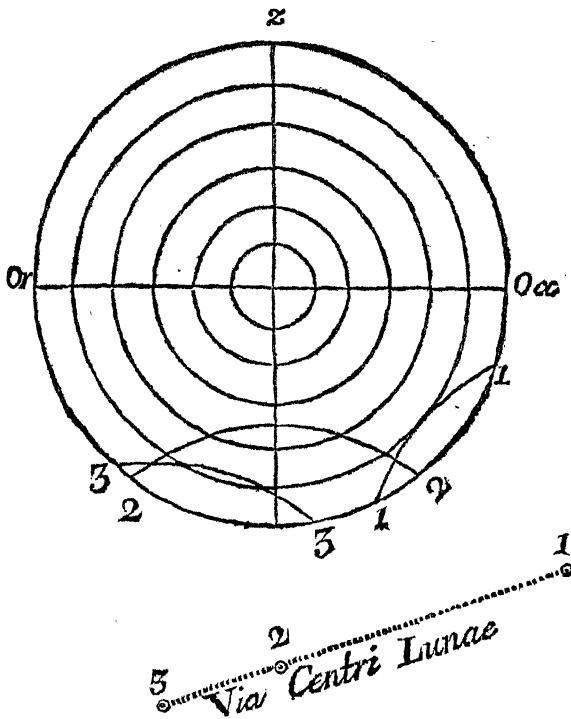
2. *Eclipsis Solis, Tubo 7 ped. Micrometro D. Grahami instructo, d. 4 Aug. paulo post meridiem 1738. Upsaliæ observata à D^{no}. Andrea Celfio, R. S. Lond. S. & R. S. Succ. Secr.*

Temp. ver.					
h.	'	"			
12.	18.	52	:	:	Initium eclipseos.
12.	35.	57	.	.	Dig. eccl. o. $5\frac{2}{3}$
12.	37.	47	.	.	o. $3\frac{1}{3}$
12.	42.	22	.	.	Finis.
0.	23.	30	.	.	Duratio.

Propter nubes per vices solem obtegentes maximam obscurationem & ceteras eclipseos phases observare non licuit; maximum tamen solis defectum dig. o. 8' h. 12. 30' 37" accidisse ex hisce observatis deducitur.

3. *Tres Phases Eclipseos Solis partialis Vitembergæ die xv. Augusti St. N. iv. St. Vet. anno MDCCCXXXVIII. à Jo. Frid. Weidlero, R. S. Lond. Sodal. observatæ.*

ETfi propter nubes, quibus tum cœlum involvebatur, nec initium, nec finis deliquii spectari potuerit, apparuerunt tamen, distractis subinde venti impetu nubibus, Phases sequentes;



Hor. Min.

- | | | |
|-----|-----|--|
| 11. | 30. | Notata est phasis prima deliquii crescentis, 1 digit. |
| 12. | 19. | <i>p. m.</i> visa est phasis altera 2 digit. 30 Minutorum. |
| 12. | 37. | Apparuit phasis decrefcentis eclipsis tertia. |

Spectatæ

Speſtatae etiam ſunt eodem tempore maculae in diſco Solis decem.

Ceterum Lunae diſcus ſub Sole, peripheriam accurate terminatam, abſque ulla inaequalitate, necnon faciem nigerrimam oſtendit. Nullum quoque Atmosphaerae orbi Lunae inſidentis veſtigium potuit deprehendi.

Aberravit calculus, ex Tabulis *Ludovicianis* deductus, quoad magnitudinem & tempus ſummæ Eclipſos. Magnitudo enim prædicebatur 2 digitorum, 20 minutorum; Medium h. 12. m. 5.

4. Defectus Solis, *observatus e specula Bononiensis Scientiarum Instituti die 15 Augusti M.DCC.XXXVIII. mane, referente Eustachio Manfredio ejusdem instituti Astronomo, & R. S. Lond. S.*

CUM Solis diſcus per hoſce dies maculis pluribus ſcateret, ipſo mane instantis Eclipſeos circiter horam 21. 30 poſt meridiem, *Eustachius Zanottus, Phil. Doct. Math. Professor publicus, Collega meus*, ope micrometri aptati tubo pedum 8, præcipuarum poſitum inveſtigavit, quæ præſertim Australem Solis partem, (qua parte Luna ſubitura erat) obſidebant; omnes enim deſcribi neque ad rem attinebat, neque per ſpectatorum turbas licuit. Eas maculas, quarum loca deſignare potuit, ſubjectum ſchema exhibet.

Initium deliquii non persenssi ante horam 22. 52. 25 post meridiem, licet & ego tubo pedum undecim, & alii tubis aliis Solis margines diu perlustrâssent. Opinor tamen ipsum Luminarium contactum minuto saltem maturius accidisse, quam animadverterim; quod ipsum a succedentibus phasibus confirmari videtur.

Digiti Ecliptici per circulos in tabella de more exaratos, digitorum vero partes æstimatione definitæ sunt. Telescopium erat pedum 6. Imago unciarum 2, aut circiter. Phases emerfionis phasibus immerfionis certiores sunt multis de causis.

Immerfionis phafes.			Emerfionis phafes.		
Temp. ver.			Temp. ver.		
h	'	"	h	'	"
23.	0.	10	Defectus unius digiti	0.	4. 14 adhuc dig. $4\frac{4}{5}$
	11.	20	dig. 2	18.	5 dig. $4\frac{1}{2}$
	23.	56	dig. 3	22.	43 dig. $4\frac{1}{3}$
	35.	14	dig. 4 dub.	31.	50 dig. 4
	45.	14	dig. $4\frac{1}{3}$	39.	13 dig. $3\frac{1}{2}$
	47.	6	dig. $4\frac{1}{2}$	46.	50 dig. 3
	51.	14	dig. $4\frac{2}{3}$	52.	55 dig. $2\frac{1}{2}$
	55.	14	dig. $4\frac{2}{3}$	57.	31 dig. 2
	58.	14	dig. $4\frac{3}{4}$	I.	3. 26 dig. $1\frac{1}{2}$
0.	I.	46	dig. $4\frac{3}{4}$		7. 52 dig. 1
				I.	13. 4 femidigitus
Finis Eclipsæos Tubo pedum } undecim }			hor. I. 18. 1		
Tubo pedum octo			hor. I. 18. 2		

Interea maculæ Solis a Luna obteſtæ ac reſeſtæ notabantur in hunc modum.

Temp. ver.

h ' "

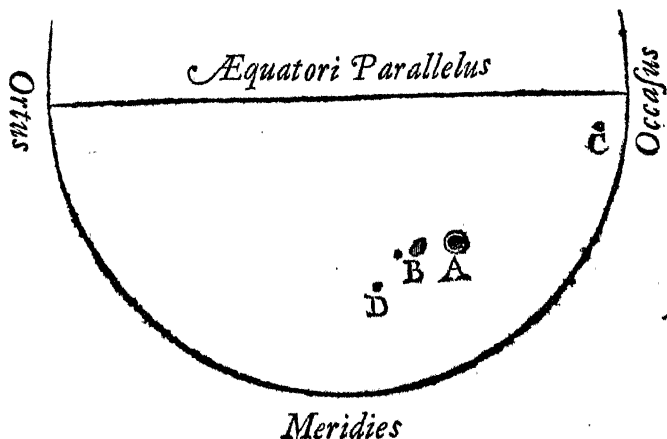
23. 3. 50 Macula *C* Lunam ſubit, tubo pedum 8.
 21. 3 Macula *A* deliteſcere incipit, tubo pedum undecim.
 21. 49 Maculæ *A* centrum occultatur.
 22. 41 Tota ſub Luna immergitur.
 23. 54 Duarum Macularum ad *B* prior immergi incipit.
 25. 10 Ejuſdem Maculæ centrum latet.
 25. 45 Tota abſconditur.
 26. 24 Duarum ad *B* poſterior centro ſuo Lunæ marginem ſubit. Haſtenus eodem teleſcopio pedum undecim.
 27. 2 Macula *D* abſcondi incipit tubo pedum 8.
 23. 31. 2 Tota deliteſcit eodem tubo.
 o. 31. 45 Macula *A* apparere incipit in ſpecie Solis per tabellam excepta.
 32. 30 Eadem macula tota cum areola ſua emerſerat tubo pedum undecim.
 33. 25. Emerſio centri prioris duarum ad *B* eodem tubo.
 34. 59 Totalis emerſio ejuſdem Maculæ eodem tubo.
 35. 51. Poſterior duarum ad *B* tota emerſerat, tubo eodem.

Obſervationes tam macularum, quam digitorum eclipticorum habuerunt (præter *Zanottum*) *Franciſcus Vandellius Mutinenſis Inſtit. Scient. Profeſſor,*
Thomas

Thomas Perellus Florentinus, M. D. Joseph. Roverfius, Petronius Matheucius, Jo. Andreas Boldrinus Placentinus, Salvator Oliva Mediolanensis, atque alii. Omnes ex eodem horologio tempora notârunt, quæ postmodum à meridianis observationibus correctâ consignavimus.

Vigente Eclipsi observavi transitum Lunæ ac Solis per planum semicirculi muralis juxta meridianum suspensi.

Ad definiendum Lunæ transitum, tempus notavi, quo segmentum perexiguum e disco Lunæ in Sole conspicuo filo horizontali telescopii subtensum, a verticali filo bissectum apparuit : tunc enim oportet ipsum Lunæ centrum in verticali extitisse. Transiit autem centrum Lunæ ante centrum Solis secundis horariis 34. hoc est hora 23. 59. 26 post meridiem diei 14. Altitudo Meridiana limbi borei Lunæ grad. 59. 36. 15 ; limbi borei Solis 59. 53. 0.



III. *Some Electrical Experiments, chiefly regarding the Repulsive Force of Electrical Bodies; communicated in a Letter from Granville Wheler, Esq; F. R. S. to Cromwell Mortimer, M. D. R. S. Secr.*

S I R,

THE following Experiments I made in the Autumn of the Year 1732. and repeated them to Mr. Grey the following Summer, when he came into the Country. I had then Thoughts of communicating them to you through his Hands, to whom they owe their Being, and drew them up with a Letter to him prefixed: But, unwilling to be an Author, I deferred the Communication from time to time, till the second Summer came, when I was informed, that Mr. *Dufay* had written a Letter to his Grace the Duke of *Richmond*, dated *Dec. 27. 1733.** wherein he takes Notice of the same Solution of the Repulsive Force, a Copy of which Letter I received the *September* following, inclosed in one from Mr. Grey. All Thoughts of publishing them were then laid aside, but meeting some time since with a fuller Account of them in the *Memoirs of the Academy of Sciences* for the Year 1735. by which it appeared Mr. *Dufay's* Experiments were not the same with my own, and having since received the Commands of our worthy President to communicate them, I take the Liberty at last of sending them to you, as I intended they should have passed through Mr. Grey's

* *Philosophical Transactions*, N^o 431. p. 258.

Hands,

Hands, if Mr. *Dufay* had not appeared upon the same Subject, in three Propositions, and a few Corollaries. I am, Sir, with a very great Regard,

Ottesden-Place,
Jan. 17. 1737-8.

Your much obliged,
humble Servant,

Granv. Wheler.

PROPOSITION I.

Bodies made Electrical, by communicating with an Electrical Body excited by Friction, are in a State of Repulsion with regard to such excited Bodies.

EXPERIMENT I.

I hung a fine white Thread by a Loop, to an horizontal blue Silk Line, about four Feet long, tied at each End, and at about a Foot distance from it, placed a Glass Tube two Feet and a half long nearly, and one Inch and quarter Diameter, fixed in the Centre of a circular Piece of Wood supported upon three brass Skrews, so that the Tube and pendulous Thread were parallel to each other. The Tube being rubbed, the Thread was attracted and repelled Seven or Eight times (in very good Weather, I have observed it move to and from the Tube Twelve times, at above one Foot Distance). I then tied a Piece of new smooth Packthread to the Top of the Tube, and to the Loop of the Thread hanging down as before, and again excited the Tube: The Thread, without coming once towards the Tube, went into and con-

tinued in a State of Repulsion; but if I only touched the communicating Packthread with my Finger, the white Thread immediately hastened to the Tube: And upon hanging another long Piece of Packthread, which reached the Ground, to the communicating Packthread, and again rubbing the Tube, the pendulous white Thread was so far from going into a State of Repulsion, that it became attracted to the Tube, and continued so, without shewing the least Tendency to a State of Repulsion, as long as the Virtue of the Tube lasted.

EXPERIMENT II.

I tied a Piece of small Cane about sixteen Inches long, and one fourth of an Inch Diameter at one End, and a little more at the other, at right Angles to the Top of my Tube, fixed in the same Pedestal as before, and making unequal Arms with it; and at the End of the larger Arm, a Piece of Stick traversely, about six Inches long, so as it might slide backwards and forwards to and from the Tube: This moveable short Stick at one End supported a very fine white Thread, at the other a very fine blue Silk, by which means we had now a Silk and a Thread at the same time hanging parallel to the Tube. The Thread, after the Tube was rubbed, first was attracted, but then immediately repelled, and continued a considerable time in a State of Repulsion; but upon tying to the End of the shorter Arm of Cane, a Piece of long Packthread, which reached down upon the Table, and rubbing the Tube again, the Thread continued in a State of Attraction, without being once repelled during the whole Virtue of the Tube,

as

as in the preceding Experiment. Yet the Silk, whether the long Packthread was added or not to the shorter Arm of the Cane, continued constantly attracted towards the Tube; but upon putting a short Silk only six Inches long, in the same Circumstances, it would, after some time rubbing the Tube, turn into a State of Repulsion, the upper Part first bending from the Tube, and the lower Part towards it, the upper Bending still increasing till the Whole was repelled; and, which is remarkable, the upper Part or Bending, upon the Approach of the Finger, or any Body not impregnated with Electrical *Effluvia*, flying towards it, and the under Part or Bending rather seeming to fly from it, till the Whole was saturated, and in a State of Repulsion with regard to the Tube, and then any Part of it would come to the Finger, or any other Body, not made Electrical. It is proper to add here one more Difference remarkable between the Thread and Silk: The Thread in a State of Repulsion touched with the Finger, would immediately fly towards the Tube; but the Silk in the same State, after touching several times, still continued in a State of Repulsion, and would not be attracted till squeezed from Top to Bottom between the Finger and Thumb, once, and sometimes two or three times. And farther, the Thread would immediately turn again into a State of Repulsion, whereas the Silk, after the Violence committed by the Thumb and Finger, being attracted to the Tube, would not without a good deal of rubbing the Tube, be repelled again.

N. B. The Silk was untwisted, and about one fourth part of the Thickness made use of.

COROLLARY I.

From the different State of the pendulous Silk and Threads at the same time under the same Circumstances, the former being attracted while the latter is repelled, it follows, that a mere Vibration of the Parts of the Tube is not sufficient to account for the Electrical *Phænomena*; which appears farther from the two contrary States continuing some time, and from the same Piece of Silk being at once part in a State of Repulsion, part in a State of Attraction.

COROLLARY II.

That some Bodies immediately receive and immediately part with the Electric *Effluvia*, but that others are some time before they receive it, or receive enough of it; and when they have received enough of it, part with it more unwillingly.

COROLLARY III.

That any light Body, as a Feather, after touching or nearly approaching the Tube, must fly from it: Upon Contact or a near Approach, it saturates itself with the Electric *Effluvia*, and by this means becomes itself Electrical (as is plain from its coming to all other Bodies too large to come to it); and consequently, from the foregoing Experiments, is in a State of Repulsion with regard to the Tube. As soon as it touches any other Body, it loses its acquired Electricity, and therefore may be attracted as at first.

P R O P O S I T I O N II.

Two or more Bodies made electrical by communicating with an Electrical Body, excited by Friction, are in a State of Repulsion with regard to one another; or Bodies made electrical by Communication, repel one another.

E X P E R I M E N T I.

I suspended two Pieces of white Thread, each about one Foot long, by Loops, upon an horizontal blue silk Line four Feet long, about half an Inch asunder from each other; and upon holding the excited Tube over them at a little Distance, the two Threads immediately receded from each other considerably at the Bottom. I then removed one of the Threads, and held the Tube over the other, in the same manner as before. The single Thread was not observed to move to either Side; consequently the moving of the Threads side-ways was occasioned neither by the Attraction of the cross Line, nor that of the Tube, nor by the Frame of Wood, to which the cross Line was tied at each End, but only by their Action upon each other.

I then added a third String, at the same Distance from the second, that the second was from the first, and upon holding the excited Tube over the middle one, at the same Distance from the cross Silk I did before, if the Strings continued in the same Plane, the middle one stood still, and the String on each side of it receded considerably at the bottom Part, which in this Case must necessarily happen upon a
Sup-

Supposition, that they repel one another equally; for the two contrary Forces of the outer Threads destroy each other, and consequently the middle one must remain quiet; but there was nothing to hinder the middle one from repelling the two outer on each hand sideways. If, as it often happened, the three pendulous Threads did not remain in the same Plane, they then all receded from one another equally, and formed nearly a triangular Prism; the three Threads being the three Edges, or rather a triangular Pyramid with the Top cut off.

Upon suspending four Threads at the same Distance as before from one another, if they continued in the same Plane, they all parted, but the two outermost more from their Neighbours, than the two in the middle from each other.

If they moved out of the Plane they were first in, they formed two Prisms, each extreme with the two in the middle forming one, or rather a Paralleloepiped, less at Top than at Bottom.

When five Strings were suspended, either the middlemost continued Stationary when the Plane was not altered, or if it was, they formed three Prisms.

EXPERIMENT II.

I afterwards placed two cross blue Silks, of the same Length as before, about half an Inch asunder from one another horizontally, and tied at each End; and upon each of these, at different times, hung two, three, four, and five Threads, at the same Distances as before, when every thing succeeded, as it ought to have done, upon a Supposition of their mutually repelling one another.

E X P E R I M E N T I I I .

To each of the Ends of two Threads, suspended as at first, a Feather being tied, the two Feathers manifestly receded from each other: And when three Threads had each a Feather at their Extremities, the middlemost became Stationary, and the two outer went off on each hand.

E X P E R I M E N T I V .

I suspended afterwards two, three, four and five blue silk Strings by Loops, upon one cross blue Silk, and found the several Experiments succeed in the same manner as in Threads; except that they remained a longer time before they appeared in a State of Repulsion, receded from one another more slowly, and continued much longer in the repulsive State, after the Tube was removed.

E X P E R I M E N T V .

This done, I made several Experiments, by mixing Silks of different Colours, and Silks and Threads of different Colours, and suspended them by Turns upon Silks of different Colours, whence arose several different *Phænomena*, which I shall not take Notice of here; but I must not omit mentioning, that upon suspending two black Silks at the before-mentioned Distances from each other, upon a scarlet cross Silk, they did not only open and recede from each other at the Bottom considerably, but when the Tube was held under, ran or jump'd away from each other, to the very Ends of the cross red Silk that supported them, taking two, three, or more Jumps from each other.

I observed the same of two white Silks suspended upon red Silk, but think they did not move away so briskly as the Black.

EXPERIMENT VI.

I tried whether Threads hanging parallel, as above, from a cross blue silk Line, and joined with one or more transverse Threads, so that the perpendicular Threads remained nearly parallel, would mutually repel when the Tube was held over them; they seemed to repel each other full as strongly as before. When they were joined by only one cross Thread towards the Top, the lower Parts separated considerably; when joined by two cross Threads, one towards the Top, and one towards the Bottom, they separated both in the middle Parts between the two cross Threads, and at their lower Ends under the second or lowest cross Thread. When several were tied together at the Top and Bottom, and about a Foot long, not by transverse Threads, but in a Knot at each End, they all bellied out from one another, describing a Figure generated by an Ellipsis, revolved about its greater Axis; approaching nearer to a Sphere, the stronger the repulsive Force was. And, though it was only a necessary Consequence, I could not without some Pleasure observe the Knot at the Bottom, as the Strings swelled out, sensibly rising up. I could scarce forbear imagining my Bundle of Silks, a Bundle of muscular Fibres.

EXPERIMENT VII.

I suspended two brass and afterwards two iron Wires upon a cross blue Silk, in the same manner
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as the Threads and Silks before-mentioned, and found the Experiments succeed as in Threads of the same Number, except that they did not recede so far from one another, which must necessarily follow from their greater Weight.

N. B. These Experiments were made sometimes with the Tube held over, sometimes held under the cross Line; but they generally succeeded best when the Tube was held under the Extremities of the pendulous Wires, which in this Case separated much farther, and kept their repulsive Force much longer.

EXPERIMENT VIII.

I must not omit here, that I hung up two Fragments of Barometer Tubes, each about a Foot long, by blue silk Lines going through each, so that they hung parallel, horizontal, at equal Heights, and about one quarter of an Inch asunder; upon holding the excited Tube above and under them, they manifestly receded from each other.

I suspended the same Fragments of Tubes by blue silk Lines of equal Length, from a cross blue Silk in a perpendicular Posture, each having a little red Sealing-wax at the upper End, to hinder the Strings from slipping off: The excited Tube being brought near them, they receded manifestly, especially at the lower Ends; the Distance from one another, when at Rest, being about a quarter of an Inch.

COROLLARY I.

From the repulsive State of the pendulous Threads tied transversely with two or more Threads, and bending

ing out from each other, where at Liberty, it follows that all the Threads of a Table-cloth, or other large Piece of Linen, when made Electrical, (as has been often done all over) have a Desire to fly from each other; and consequently, was the repulsive Force strong enough, the Whole would be dissolved, or torn in Pieces. A short Thread of black Silk, by repeated Applications of the Tube, I have separated into its smallest Fibres: Whence is suggested more plainly, than from any other known Experiment, a Reason for the Dissolution of Bodies in their respective Menstruums, *viz.* That the Particles of the Solvend having imbibed the Particles of the Menstruum, so as to be saturated with them, the saturated Particles become repulsive of each other, separate, and fly to Pieces.

And hence, perhaps, arises a Reason, why Particles of Bodies specifically heavier than the Menstruums in which they are dissolved, are, after the Dissolution and Dispersion, suspended all over the Menstruum, *viz.* That they repel each other. Attraction is insufficient; for Parts attracted equally in all Directions, are, in Effect, not attracted at all, and the Imperfection of the Fluid will not do; for if this occasioned the Suspension, striking or joggling the Vessel would make them subside.

COROLLARY II.

Hence we plainly see how Heat may divide the Particles of Water with greater or less Force, in Proportion to the Degree of Saturation, and throw them into the Air; where they may continue to ascend, if at the same time they are divided, they are expanded into little Shells or Bubbles, of a Diameter large enough

enough to be specifically lighter than the lower Air, as the great *Halley* has sagaciously conjectured. Or if the upper Parts of the Air, as being less saturated than the lower Parts, may be able to draw them upwards, till the Excess of Weight, which is constantly increasing, is equal to the Excess of Attraction.

PROPOSITION III.

Bodies, made Electrical by rubbing, do themselves repel one another, or the electrical excited Bodies themselves repel one another.

EXPERIMENT I.

The two Fragments of Tubes before-mentioned *, being suspended horizontally, and in a Posture parallel to each other, I held in one Hand, and with the other rubbed some time; then gently letting them go so as to be at Rest, I could plainly perceive them recede from each other towards that End which had not been taken hold of.

But as upon repeated Trials I found it difficult to make this Experiment succeed unexceptionably, the Tubes generally having some reciprocating Motion of their own, after quitting the Hand, I made use of the following Method.

I suspended a single little Tube about a Foot long, by a long blue silk Line, perpendicularly, and upon a Table placed my great Tube fixed in a Stand as before, excited each alternately, two or three times;

then gently moved the Tube with the Stand it was fixed in, near the suspended little one: The little Tube manifestly receded so much, that a cross blue silk Line stretched horizontally at about an Inch Distance on the opposite Side, would sometimes, upon the first Approach of the great Tube, be touched by it.

EXPERIMENT II.

Three scarlet Silks, pendulous each by Loops from a cross silk Line, and close together, being rubbed downwards two or three times, between the Finger and Thumb, shewed a considerable repulsive Force with regard to each other, forming themselves immediately into a triangular Pyramid, and continuing in this State of Separation some time, and which shews their Attraction at the same time, with regard to other Bodies not excited, coming to them when brought near them.

I observed the same repulsive Force in three yellow and three green Silks, under the same Circumstances, and excited in the same manner, but not in so great a Degree as in Scarlet. In Blue the repulsive Force was scarce discernible after several times rubbing.

SCHOLIUM.

The Revd Dr. *Stephen Hales*, in his 12th Article of his 13th Experiment, in his second Volume of *Statical Essays*, observes, “ That if a Piece of one
“ of the *Bronchie* or Gills of the *Muscle Shell-Fish*, be
“ cut off, and put into a small concave Glass, with
“ three or four Drops of its Liquor, and be then
“ placed under a double Microscope, the Blood may
“ be

“ be seen greatly agitated in the fine Vessels; and at
 “ the cut Edge of the Piece of Gill, may with great
 “ Pleasure be seen many Blood-globules, repelled
 “ from the cut Orifices of the Blood-vessels, and
 “ attracted by other adjoining Vessels; also other
 “ Globules rolling round their Centre, and repelling
 “ each other; whence (as he says) it is plain, that
 “ Bodies, by brisk rubbing and twirling about, may
 “ acquire, in a watry Fluid, both attractive and re-
 “ pulsive Virtue or Electricity.”

From our last Experiments we are led to think, that the Globules of the Blood, if by Friction they acquire an electrical attractive Virtue, must of necessity repel one another; and that Electricity is not so properly called an attractive and repulsive Virtue, as a Virtue attractive of those Bodies that are not attractive themselves, and repulsive of those that are; and that this repulsive Force of the electrical Blood-globules, excited by Friction, as they flow in their Channels (and particularly in the small ones, and perhaps more so in those of the Lungs, where the refrigerating Power of the Air may assist, as Dr. *Hales* has observed); this repulsive Force of the Blood-globules, I say, may be the great Cause that hinders the Blood from coagulating as it circulates; may be the great Cause of the constant Perspiration in an healthy State, and of the Increase of it, *cæteris paribus*, in Proportion as the Velocity and Friction of the Blood increases.

If these things are so, the Necessity of Exercise appears more plainly than ever, in order to keep the Body in an healthy State, as we may observe here the very Steps that Nature makes use of to free herself from her Suppressions.

Granv. Wheeler.

III. *An Account of some of the Electrical Experiments made by Granville Wheler, Esq; at the Royal Society's House, on May 11. 1737. drawn up by C. Mortimer, M. D. R. S. Secr.*

EXPERIMENT I.

A Large Octavo Book was placed horizontally upon silk Lines, and the upper Surface strewed with several Pieces of leaf Brass, all or the greatest Part of which flew upwards, from one another, and off the Book, upon holding an excited Tube at a little Distance underneath the Book.

EXPERIMENT II.

Two Lines were extended horizontally the whole Length of the Library being between 30 and 40 Feet, distant from one another about two Feet at one End, and meeting together in a Knot at their other Ends, the whole Lines being Packthread, except five Feet of silk Line tied at each of the separated Extremities, as well as at the Knot where the other Ends united, in order to stop the Current of the *Effluvia*. Upon the united Extremities was placed horizontally a Piece of Card about two Inches square, on which were strewed Pieces of leaf Brass: The excited Tube being held at a little Distance under the separated Extremities of the Packthread, the leaf Brass on the Card at the other End flew upwards, and off the Card.

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E X P E R I M E N T I I I .

Five glafs Receivers placed one within another upon an electrical Cement of Bees-wax and *Venice* Turpentine, were all exhausted : In the innermost a fine white Thread about five Inches long, was suspended from the Crown of it, by the Assistance of a little Cement made of Bees-wax and Oil. Upon moving the excited Tube up and down near the Side of, and horizontally to and from the outward Receiver, the suspended Thread manifestly made many Vibrations corresponding to the Motions of the Tube.

E X P E R I M E N T I V .

An electrical circular Cake of Bees-wax and Rosin, ten Inches in Diameter, was placed horizontally upon a tall glafs Receiver near three Feet high, such as is made use of for the dropping the Feather and Guinea. This Cake being, the preceding Evening about Eight o'Clock, warmed with an hot Iron held over it, and then struck perpendicularly all over its Surface with the Hands in parallel Directions, and so left cover'd with a thin Pasteboard, was about Twelve o'Clock next Day at Noon gently uncover'd, and an ivory Ball about one Inch and half Diameter placed in the Centre, a fine white Thread about ten Inches long, with a small Piece of Cork, the Size of a Pin's Head, at the End of it, being held between the Finger and Thumb, was gently let down upon the Vertex of the Ball ; it first flew off at some Distance, and then made several pretty regular Revolutions from West to East about it, in the Form of a Circle.

E X P E R I M E N T V.

The Ball was removed, and the Cake again warmed and excited as before; after which the Ball was replaced at a little Distance from the Centre, nearer to Mr. *Wheler*; the Consequence of which was, that the pendulous little Body moved with a direct Motion as before, but in an Orbit that resembled an Ellipse, having the Ball in one of its *Foci*.

E X P E R I M E N T VI.

Two Bullets fixed on little Stands of Cork about one quarter of an Inch high, were placed upon the Cake, each about an Inch distant from the Centre of it, and in a Line with the Centre and Mr. *Wheler*; the pendulous Body described an Orbit resembling an Ellipse, having the two Bullets for its *Foci*, and the Motion was direct from West to East.

E X P E R I M E N T VII.

Instead of the Cork, another pendulous Body of a cylindrical Form was made use of, tied to a fine white Thread about twenty Inches long; the Cylinder consisted of two circular Bases of Paper half an Inch Diameter, but all cut away except a Ring and a small Bar cross the Middle, through which Basis six equal fine Threads passed at equal Distances from one another, knotted at the lower Base separately, and joined together in one Knot at about half an Inch Distance from the upper Base, from which Knot proceeded the long Thread. This Body moved from West to East about the central Ball, and at the same time discover'd

a Motion about its own Axis in the same Direction; but after two or three Turns generally stopt, and turn'd the contrary Way, which seem'd to arise from the untwisting of the Thread.

EXPERIMENT VIII.

A Thread about a Foot long, was suspended from an horizontal Line of Packthread, parallel to it an excited Tube placed erect in a Stand, the Thread approached the Tube, and continued in a State of Attraction: A Thread of the same Length, suspended from a silk Line, vibrated backward and forwards two or three times, being first attracted, and then repelled, and continuing some time repelled; but upon joining the Top of the Tube, by a Packthread going round it, to the Loop of the Thread, the Thread continued constantly in a State of Repulsion, shewing no Tendency to Attraction.

EXPERIMENT IX.

Two black Silks, about the same Length with the Thread in the preceding Experiment, were suspended by Loops from an horizontal red silk Line, at the Distance of about half an Inch from each other; upon holding the excited Tube under them, the Silks swelled out from one another, and then jump'd away on each Hand to the Distance of two Feet.

EXPERIMENT X.

A 'circular Board' of nearly the same Diameter with the electric Cake, was suspended horizontally by six silk Lines, tied to one silk Line which was brought

over a Pulley at the Top of a Frame of Wood, so as to be moved up and down. From the Board hung six fine white Threads about eighteen Inches long, fixed by a little Cement at equal Distances from each other. The Board being let down till the Ends of the Threads were about an Inch distant from the electric Cake, which was directly under, and had the ivory Ball on its Centre; the Threads all approached towards the Centre of the Cake, both when the Ball was in the Centre, and when taken away, keeping an equal Distance from the Centre, and from one another, as long as a Packthread joined the Circle of Board and the Frame to keep it steady; and upon removing the Ball out of the Centre towards the Circumference, the Figure lengthen'd, the Threads next the Ball advancing nearer the Circumference; when the Ball was placed at about an Inch Distance from the Circumference, the Thread that was before nearest the Circumference, whipp'd between the Ball and the Centre, so as to be almost in the same Plane with its two neighbouring Threads, the Figure form'd by the Extremities resembling an Ellipse with one End cut off: But when instead of the Packthread that join'd the Board to the Frame, a blue silk Line was tied in the same manner in all respects, the Threads, instead of coming towards the Centre, all flew away at a great Distance from the Cake, and from one another.

It ought to be observed in the Experiments of the circular Motion of the pendulous Body, that Mr. *Wheeler's* Hand seem'd as steady as possible, except in the first Experiment, when a little Trembling appear'd; Mr. *George Graham* taking a very good Method to observe

observe it, by keeping his Eye fix'd upon a Point at a considerable Distance, in the same Line with the End of Mr. *Wheler's* Finger, and his own Eye.

Yet when Mr. *Wheler* had finish'd the Experiments to the Satisfaction of all present, Mr. *Hawskbee*, Mr. *George Graham*, and Dr. *Mortimer*, held the Thread with the pendulous Body over the Cake with the Ball on its Centre, after the Cake had been excited by Mr. *Wheler* ; but they had no regular Revolutions at all, though several very manifest Motions were made with the Hand, to try if a projectile Motion might by that means be given to the pendulous Body. Mr. *Wheler* had tried the same thing with his Servant ; from whence it is reasonable to conclude, that it is necessary, that the same Person who excited the Cake should likewise hold the Thread ; as if there were some Analogy between the *Effluvia* excited by the clapping of the Hand on the Cake, and the *Effluvia* which may be communicated along from the Hand which holds the Thread to the Piece of Cork at the End of it. And this seems to be the Reason of what the late Mr. *Grey* told me, *viz.* That there was something in the human Hand essential to the Experiment, which he had not yet found in any other Supporter of the Thread.

IV. *A Letter from Granvile Wheeler, Esq; to Dr. Mortimer, Secr. R. S. containing some Remarks on the late Stephen Gray, F. R. S. his Electrical Circular Experiment. **

S I R,

SOME odd Circumstances led me to make Mr. Gray's circular Experiment in the following Manner. While I excited a Cake of Rosin and Beeswax ten Inches Diameter, by clapping with my Hand, I let my ivory Ball continue in a Basin of Water; then shaking off the Drops, placed it in the Centre, and with my right Hand held a fine Thread; about eight or nine Inches long, having one End rolled up into a little Ball, and the other, for about an Inch, reduced to its greatest Fineness, to only one Fibre, myself and Hand being supported on the Back of a Chair. The Success was, I had a great many Revolutions, to the Number of Fifty, from West to East; but at first not so regular as towards the last, at first describing only about one third Part of the Circumference at a time, and after standing still a little, describing another third Part. I might probably have had a great many more Revolutions, but being tired, I was forced to rest myself, which I did for ten Minutes, then took up the Thread again. The Thread stood repelled at some Distance, without making any Revolutions, and at last only made half an one the contrary way to what it did before; but upon wetting it, by drawing it two or three times

* See *Philosophical Transactions*, n. 441, p. 220. and n. 444, p. 400. of the Revolutions of *pendulous Bodies* by Electricity.

over the Surface of the Water, it made again twenty more Revolutions from West to East, only at a smaller Distance from the Ball, (for the Water must make it heavier) but full as regular as before, and rather quicker: The Virtue of the Cake must now have lasted about three quarters of an Hour. After resting about six Minutes, I tried again with the String fresh wetted, the Ball and Cake continuing as before; and had, to my great Surprise, one hundred Revolutions in the Space of about twelve Minutes, the Revolutions being still quicker, and more regular, and nearer the Ball; and at the sixth Revolution of this last Hundred, the Thread was attracted to the Surface of the Ball, and, being wet, did not disengage itself, till pulled away; yet after this, described the remaining Ninety-four Revolutions of the Hundred, and seemed inclined to describe a great many more, but that I was forced to rest my Arm again, which I did for about eight Minutes, then tried again, the Thread being fresh wetted, and had seventy Revolutions at nearly the same Distance from the Ball in less than nine Minutes, all very regular, and without any Attraction of the Thread to the Ball. I rested again sixteen Minutes, wet the Thread again, and held it as usual; it was repelled at about half an Inch Distance from the Ball, but seemed to have no Tendency to a circular Motion; yet after continuing stationary about a Minute, I perceived a Motion about its Axis, about which it took several Turns; but still had little or no progressive Motion, till about a Minute longer, when it began to move forward, and continued doing so from West to East, for about thirty-three Revolutions, very regular, but slower than in the two last Cases, the String having been held about ten Minutes,

nutes, and the Revolutions performed in about seven or eight of them. I observed each of these three last times, it was rather longer before the progressive Motion began than usual; and in all the Trials of this Experiment, I frequently perceived a Motion about the Axis, which was generally from West to East, though now-and-then the contrary Way. The Virtue of the Cake must now have lasted near two Hours; about three quarters of an Hour after, I tried again, and had sixty Revolutions from West to East, in about ten Minutes, the Distance from the Ball being still less than before, hardly one quarter of an Inch, scarce any Revolution about the Axis appeared, and at the Beginning the Thread was twice attracted to the Ball. About an Hour and half after, the Virtue of the Ball was not quite gone, the wet Thread being repelled, and making three or four Revolutions from West to East, as well as moving a little about its Axis the same Way. But as it was reasonable to suppose the Ball itself in the Centre of the Cake was now dry, with a Feather dipp'd in Water I wet its Surface; yet found no Increase of Virtue, rather a Diminution of it, the pendulous Body seeming scarce at all repelled; but it is to be observed, that the Ball, as it was wetting, twice tumbled over, and rolled upon the Surface of the Cake; by which means the Virtue of the Cake might be much diminished.

It is not improper too to take Notice here, that during the Revolutions of the wet String, I have frequently observed a kind of Oscillatory Motion, as it there was an alternate Intention and Remission of the repulsive Force. As also that I have often took Notice of little Plucks, and convulsive Motions,

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in the pendulous Body, and sometimes thought I have felt something like it in my Arm that held it, though at no other time have I ever been sensible of any such thing.

I have several times since repeated this Experiment with the Thread and Ball both wet, and found it succeed much better than when they were both dry; and once I find by my Notes I had two hundred and twenty Revolutions before I rested my Arm. I have tried too with the Ball dry, and the String only made wet; but the Virtue did not continue so long, as when both were wet.

I now flattered myself with Hopes of Success, if the Thread was suspended from an undoubted fixed Point, which therefore I proceeded again to try with the greatest Care and Caution, but in vain; the Revolutions were uncertain.

This Difference naturally led me to reflect upon the Cause of it. The Tremor of the Hand would not account for it; for this being both ways backward as well as forward, must as often hinder as promote a continual Motion one way: And though in two opposite Parts of a Circle, the Motion is really in contrary Directions, and therefore the contrary Impulses of a Tremor may promote a Revolution applied at opposite Places of the Orbit; yet as these Tremors are irregular, and succeed much quicker than the Revolutions are perform'd, they seem insufficient to account for the Motions of the pendulous Body, performed with any Degree of Regularity.

A Stream of Air in my Room might impel along the Tangent the pendulous Body, kept at a Distance from the Ball by its repulsive Force; and then Gravity,

taking place, might with the first Motion compound a Curve; but still the Resistance of the Air would soon destroy the original Impulse, could a few Revolutions be performed; and besides, one Revolution could not be performed, because the same Stream of Air that began the Motion, must be contrary to it in its Return.

A Finger held on the right Hand near the pendulous Body, when suspended from a fixed Point, will make it revolve from West to East; but then it must be applied and removed alternately: The repulsive Force therefore which the Arm may acquire, by being held in the Sphere of the *Effluvia*, is insufficient; for, as it is in one Place, it must impel only one way, and constantly the same way; and therefore, like a Stream of Air in the Room, though it might create the Beginning, it must hinder the Completion of a Revolution.

Sometimes I have doubted, whether the Pulse of the Arm might not be assisting in giving a projectile Motion. When one Leg is laid over the Knee of the other, a Motion and Heaving of the Leg that lies over, answering to every Stroke of the Pulse, is very apparent at a Distance: The Arm therefore in some Postures, in which its great Artery meets with a proportionable Pressure or Resistance, may have a constant Motion, though less perceivable.

What seemed the most probable Solution, was this: When the Arm is extended, the Posture being uneasy, there must be a Reaction of the Muscles, or a continual pulling of the Arm towards the Body. When therefore the right Arm is made use of, the pulling will be from Right to Left; and consequently the

the Motion produced in the Body held by it in the same Direction, or from West to East. When the left Arm is made use of, the Reaction of the Muscles will be from Left to Right, and therefore the Motion of the pendulous Body from East to West. And, agreeably to this, I have observed, (as I formerly took Notice, though this Reason did not then occur to me) when I used my left Hand, all other Circumstances continuing the same, the Motion of the pendulous Body was from Left to Right, or from East to West, contrary to what was observed when held by the right Hand.

Yet still neither of these Solutions would account for the Variety of Oddnesses I have met with under various Circumstances.

I proceeded therefore to try with Rests for my Arm of different Heights, having an Arm of Wood, about two Feet long, fixed to a Rest for my Telescopes, which I could raise to any Height I wanted; and I found the Experiment succeed only well, when the Rest was lower than the electric *Area*, and the Arm was supported upon its Elbow, which was the Posture constantly made use of, when rested upon a Chair, the Chair being lower than the electric *Area*, that it might less affect the *Effluvia*, as was then thought.

I began now to think with myself, whether it was not possible, that an Inclination to a Motion one way in the Person that holds the Body, might not have such an Influence upon the Arm, and consequently the String and pendulous Body, as to determine them the same way by some Pressure or Byass put upon it, though no Motion sensible even to him-

self, was produced in the Hand. If so, I might, by a contrary Inclination, produce a Motion the contrary way. Having therefore a fine Day, and my circular Cake being well excited, I tried if I could not produce a regular Motion from East to West, about the Ball in the Centre, having my Hand supported, as usual, upon the Back of a Chair. I found I could produce a very regular one from East to West for many Revolutions, and change from one Motion to another, without being sensible I moved my Hand at all.

I then wet the Ball and String, as in the Experiment before-mentioned, and found I could tire myself with a Motion either from East to West, or from West to East, as I pleased, without giving any Motion, that I could perceive, to my Hand or Fingers. Hence many odd Experiments that please, may, when repeated, succeed.

Since therefore the Motion of the pendulous Body from a Point undoubtedly fixed, is irregular, as I have found by many different Experiments, repeated with the greatest Care and Caution; and since I am convinced from these last-mentioned Trials, the Motion from West to East, and from East to West, must generally have been determined by myself; I am inclined to think, that a Desire of producing a Motion from West to East, was the secret Cause that determined the pendulous Body to that Direction, by some Impression from Mr. *Gray's* Hand, as well as my own, though I am persuaded at the same time, he was not sensible of giving any Motion to his Hand himself: And I the rather think this was the Case, from the Instance Mr. *Gray* gives, by way of Explanation,

nation, of a Man resting his Elbows upon his Knees, this implying that he rested his Arm upon his Elbow, as I did myself.

But though upon the Whole it does at last appear, that this Motion from West to East in a pendulous Body, applied to another in the Centre of an electric *Area*, is to be ascribed to the Hand that holds it, and not solely to the Nature of the electric *Effluvia*, or the Figure of the central Body; yet still, perhaps, it may not be improper for Astronomers to consider, whether or no a Medium with this Property, that all Bodies immersed in it, are repulsive of one another, ought not to be joined with Gravity to explain the heavenly *Phænomena*; especially since the *Phænomena* of Fire, and our electric *Effluvia*, have a great Affinity to each other; and since many of the heavenly *Phænomena* are to be accounted for, upon this Supposition, with great Simplicity; and some of them, that have not yet perhaps been fully accounted for, seem necessarily to follow.

I am, Sir, with a very great Regard,

Otterden-Place,
Feb. 20. 1737-8.

*Your much obliged,
humble Servant,*

Granv. Wheler.

P S. This was intended to have been sent eleven Days ago.

Mar. 3. 1737-8.

V. *An Account of the Influence which two Pendulum Clocks were observed to have upon each other, by Mr. John Ellicott, F. R. S.*

THE two Clocks upon which the following Observations were made, being designed for Regulators, particular Care was taken to have every Part made with all possible Exactness : The two Pendulums were hung in a manner different from what is usual ; and so disposed, that the Wheels might act upon them with more Advantage. Upon Trial they were found not only to move with greater Freedom than common, but an heavier Pendulum was kept in Motion by a smaller Weight. They were in every respect made as near alike as possible. The Ball of each of the Pendulums weighed above 23 lb ; and required to be moved about 10 5' from the Perpendicular, before the Teeth of the swing Wheel would scape free of the Pallets ; that is, before the Clocks would be set a going. The Weight to each was 3 lb, which would cause either of the Pendulums in their Vibrations to describe an Arch of 30. The two Clocks were each in Cases, which shut very close, and placed Sideways to one another, so near that when the Pendulums were at Rest, they were little more than about two Feet asunder. The odd *Phænomena* observed in them were these : In less than two Hours after they were set a going, one of them (which I call N^o 1.) was found to stop ; and when set a going again, (as it was several times) would

would never continue going two Hours together. As it had always kept going with great Freedom, before the other Clock (which I call N^o 2.) was placed near it, this led me to conceive its stopping must be owing to some Influence the Motion of one of the Pendulums had upon the other; and upon watching them more narrowly, I found the Motion of N^o 2. to increase as N^o 1. diminished; and at the time N^o 1. stopped, N^o 2. described an Arch of 5°, that is nearly two Degrees more than it would have done, if the other had not been near it, and more than it did move in a short time after the other Pendulum came to be at Rest: This made me imagine that they had a mutual Influence upon each other. Upon this I stopped the Pendulum of N^o 2. leaving it quite at Rest, and set N^o 1. a going, the Pendulum describing as large an Arch as the Case would permit, *viz.* about 5°. In about 20 Minutes after, I went to observe whether there was any Motion communicated to the Pendulum N^o 2. when, to my Surprise, I found the Clock going, and the Pendulum to describe an Arch of 3°, whereas at the same time N^o 1. did not move 4°. In about half an Hour after, N^o 1. stopped, and the Motion of N^o 2. was increased to very near 5°. I then stopped N^o 2. a second time, and set N^o 1. a going, as before; and standing to observe them, I presently found the Pendulum of N^o 2. to begin to move, and the Motion to increase gradually, till in 17' 40" it described an Arch of 2° 10', at which time the Wheel discharging itself of the Pallets, the Clock went. The Arches of the Vibrations continued to increase, till (as in the former Experiment) the Pendulum moved 5°; the
Motion

Motion of the Pendulum N^o 1. gradually decreasing all the while, as the other increased; and in three Quarters of an Hour after, it stopped. I then left the Pendulum of N^o 1. at Rest, and set N^o 2. a going, making it describe an Arch of 50°; it continued to vibrate less and less, till it described but about 30°; in which Arch it continued to move all the time I observed it, which was several Hours. The Pendulum of N^o 1. seemed but little affected by the Motion of N^o 2. I tried these Experiments several times over, without finding any remarkable Difference. The freer the Room was from any Motion (as Peoples walking about in it, &c.) I found the Experiments to succeed the better; and once I found N^o 2. set a going in 16' 20'', and N^o 1. at that time stopped in 36' 40''.

I shall not offer my Opinion to this Honourable Society, concerning the Cause of these *Phænomena*, or at least not till I have farther examined it by the Help of some more Observations and Experiments.

VI. *Further Observations and Experiments concerning the two Clocks above-mentioned, by the Same.*

IN the preceding Paper I had the Pleasure to communicate to this Honourable Society, an Account of the extraordinary Influence I observed two Clocks to have upon each other, and which was attended with such Circumstances, as I believe had never before been taken Notice of. I shall now beg
Leave

Leave to lay before you some farther Observations I have since made, which will, I hope, in great measure, account for the Facts then related.

In my former Account I took Notice, that the two Clocks were in separate Cases, and that the Backs of them rested against the same Rail; that the Pendulums, when at Rest, were about two Feet asunder, and weighed about 23 lb each, and were made to move with such Freedom, that a Weight of 3 lb. would cause either of the Pendulums to describe an Arch of three Degrees. The most remarkable Particulars then observed in them were these: If the Pendulum of one of the Clocks, which (for Distinction sake) I called N^o 2. was left at Rest, and that of the other, which I called N^o 1. was set a going, this would, in about 16 Minutes, communicate so great a Quantity of Motion to N^o 2. as would make its Pendulum describe an Arch of above two Degrees, and would set the Work a going: That the Motion of the Pendulum of N^o 1. constantly decreased as that of N^o 2. increased, and after about 30 Minutes it did not describe an Arch sufficient to free the Teeth of the Wheel from the Pallets, so that the Clock stopped. At the same time the Pendulum of N^o 2. described an Arch of five Degrees, which was two Degrees more than it would have done, had it not been affected by the Motion of N^o 1. Upon leaving the Pendulum of N^o 1. at Rest, and setting N^o 2. a going, the Pendulum of N^o 1. was found to be but little affected, and never moved sufficiently to set the Work a going. These seemingly different Effects, which the two Clocks had upon each other, I shall now endeavour to account for.

The Manner in which the Motion is communicated to the Pendulum at Rest, I conceive to be thus : As the Pendulums are very heavy, when either of them is set a going, it occasions by its Vibrations a very small Motion, not only in the Case the Clock is fixed in, but, in a greater or lesser Degree, in every thing it touches; and this Motion is communicated to the other Clock, by means of the Rail, against which both the Cases bear. The Motion thus communicated, which is too small to be discovered but by means of some such-like Experiments as these, will, I doubt not, be judged by many, insufficient to make so heavy a Pendulum describe an Arch of two Degrees, or large enough to set the Work a going; and indeed it would be so, but for the very great Freedom with which the Pendulum is made to move, arising from the Manner in which it is hung. This appears from the very small Weight required to keep it going, which, when the Clock was first put together, was little more than one lb. And if the Weight was taken off, and the Pendulum made to swing two Degrees, it would make 1200 Vibrations before it decreased half a Degree, so that it would not lose the $\frac{1}{3000}$ part of an Inch in each Vibration. Indeed if the Weight was hung on, the Friction would be increased, and the Pendulum would not move quite so freely; but even in that Case it was found to lose but little more than the $\frac{1}{2000}$ part of an Inch, or about three Seconds of a Degree, in one Vibration; and therefore if the Motion communicated to it from the other, will make it describe an Arch exceeding three Seconds, the Vibrations must continually increase till the Work is set a going. And

And that the Motion is communicated in the manner above supposed, is confirmed by the following Experiments:

A Prop was set against the Back of the Case of N^o 2. to prevent its bearing against the Rail; and N^o 1. was set a going; then observing them for several Hours, I could not perceive the least Motion communicated to N^o 2. I then set both the Clocks a going, and they continued going several Days; but I could not find they had any Influence upon each other. Instead of the Prop against the Back of the Case, I put Wedges under the Bottoms of both the Cases, to prevent their bearing against the Rail; and stuck a Piece of Wood between them, just tight enough to support its own Weight. - Then setting N^o 1. a going, I found the Influence so much increased, that N^o 2. was set a going in less than six Minutes, and N^o 1. stopped in about six Minutes after. In order to try what Difference would arise, if the Clocks were fixed on a more solid Floor, I placed them (exactly in the same manner as in the last Experiment) upon the Stone Pavement under the Piazza's of the *Royal Exchange*, and stuck the Piece of Wood between them, as before; and setting N^o 1. a going, the only Difference I could perceive, was, that it was 15 Minutes before N^o 2. was set a going, and N^o 1. continued going near half an Hour before it stopped. From these Experiments I think it plainly appears, that the Pendulum which is put in Motion, as it moves towards either side of the Case, makes the Pressure upon the Feet of the Case to be unequal, and, by its Weight, occasions a small Bearing or Motion in the Case on that Side towards which the

Pendulum is moving; and which, by the Interposition of any solid Body, will be communicated to the other Clock, whose Pendulum was left at Rest. The only Objection to this, I conceive, is the different Effects which the two Pendulums seemed to have upon each other. But this I hope to explain to Satisfaction.

For, notwithstanding these different Effects, I soon found, by several Experiments, that the two Clocks mutually affected each other, and in the same Manner, though not with equal Force; and that the Varieties observed in their Actions upon each other, arose from the unequal Lengths of their Pendulums only.

For, upon moving one of the Clocks to another Part of the Room, and setting them both a going, I found that N^o 2. gained of N^o 1. about one Minute 36 Seconds in 24 Hours. Then fixing both against the Rail, as at first, I set them a going, and made the Pendulums to vibrate about four Degrees; but I soon observed that of N^o 1. to increase, and that of N^o 2. to decrease; and in a short time it did not describe an Arch large enough to keep the Wheels in Motion. In a little time after it began to increase again, and in a few Minutes it described an Arch of two Degrees, and the Clock went. Its Vibrations continued to increase for a considerable time, but it never vibrated four Degrees, as when first set a going. Whilst the Vibrations of N^o 2. increased, those of N^o 1. decreased, till the Clock stopped, and the Pendulum did not describe an Arch of more than one Degree 30 Minutes. It then began to increase again, and N^o 2. decreased, and stopped a second time, but
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was set a going again, as before. After this N^o 1. stopped a second time, and the Vibrations continued to decrease till the Pendulum was almost at Rest. It afterwards increased a small matter, but not sufficiently to set the Work a going. But N^o 2. continued going, its Pendulum describing an Arch of about three Degrees.

Finding them to act thus *mutually* and *alternately* upon each other, I set them both a going a second time, and made the Pendulums describe as large Arches as the Cases would permit. During this Experiment, as in the former, I sometimes found the one, and at other times the contrary Pendulum to make the largest Vibrations. But as they had so large a Quantity of Motion given them at first, neither of them lost so much during the Period it was acted upon by the other, as to have its Work stopped, but both continued going for several Days without varying one Second from each other; though when at a Distance, as was before observed, they varied one Minute 36 Seconds in 24 Hours. Whilst they continued thus going together, I compared them with a third Clock, and found that N^o 1. went one Minute 17 Seconds faster, and N^o 2. 19 Seconds slower, than they did when placed at a Distance, so as to have no Influence upon each other.

Upon altering the Lengths of the Pendulums, I found the Period in which their Motions increased and decreased, by their mutual Action upon each other, was changed; and would be prolonged as the Pendulums came nearer to an Equality, which from the Nature of the Action it was reasonable to expect it would. This discovers the Reason why the Pendulum

dulum of N° 2. when left at Rest, would be set a going by the Motion of N° 1. whereas if N° 1. was left at Rest, it would not be set a going again by the Motion of N° 2.

For I found by several Experiments, that the same Pendulum, when kept in Motion by a Weight, would go faster, than when it only moved by its own Gravity. On this Principle, which may easily be accounted for, it follows, that during the Time in which the shortest Pendulum, N° 2. was only acted upon by N° 1. it would move slower, and the Times of its Vibrations approach nearer to an Equality with those of N° 1. than after it came to be kept in Motion by the Weight; and by this means the Time which N° 1. would continue to act upon it, would be prolonged, and be more than was required to make the Pendulum describe an Arch sufficient to set the Work a going. But on the contrary, while the Pendulum of N° 1. which was the longest, was only acted upon by N° 2. as it would move slower, the Difference of the Times of the Vibrations would be increased; and consequently the Time which N° 2. would continue to act upon it, would for this Cause be shortened, so that before the Pendulum of N° 1. would describe an Arch sufficient to set the Work a going, the Period of its being acted upon would be ended, and it would begin to act upon N° 2. at which time its Vibrations would immediately decrease, and continue to do so till it came to be almost at Rest. And thus it would continue sometimes to move more, and at other times less, but never sufficiently to set the Clock a going.

This

This Account might be confirmed by many more Experiments I have made relating to this Subject; but as I hope these already mentioned will be thought sufficient to confirm the Truth of what I have advanced, I shall forbear to trespass any longer on your Time, and subscribe myself

*Your most obedient
humble Servant,*

John Ellicott.

VII. *The Case of a Wound in the Cornea of the Eye being successfully cured by Mr. Tho. Baker, Surgeon to St. Thomas's Hospital, and by him communicated to the ROYAL SOCIETY, in a Letter to Dr. Mortimer, R. S. Secr.*

A Young Woman, about the Age of 15 Years, on the 6th Day of *November* 1733, received a Wound just in the Pupil of her right Eye, by the Spear of a common Fork. An Inflammation followed, with great Pain. The whole Eye appeared dark and turbid; and the Humours seemed confused, and blended together. I opened a Vein in the Arm, and drew away 10 Ounces of Blood: I then washed the Eye with a Collyrium of *Trochisci Albi Rhafis*, and common Water, made Blood-warm; and dressed it with a Cataplasm of white Bread and Milk, with a little Saffron in it. The next Day there appeared
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on the wounded Part of the *Cornea*, a large thick Slough: I dressed her in the same Manner, and so continued till the 18th Day of the same Month, when the Slough cast off. I purged her during this Time with *Decoct. Sennæ* ʒij, *Mann. Solut.* ʒss, *Aq. Pæon. comp.* ʒij; *m. f. Pot.* at the Distance of about three Days, just as I found her Strength would permit. The Inflammation and Pain abated daily. During the whole Time, the Eye was quite blind, till the Slough cast off, when she complained she saw double. In a very little time her Sight returned, but not so perfect as before; her Eye having somewhat of a Cloud before it.

I made her six Visits at the Distance of two or three Days after the 18th: When I left her, she saw perfectly well, that Cloud which she before complained of, being removed; her Eye appeared fair and clear; and, as she told me, was equally strong and useful to her as her other. A little Speck (which was the Cicatrix of the Wound) remaining on the *Cornea*, I made her a Fontanel in the Arm, and ordered her to keep it open, and not to touch the Speck on her Eye. It is now more than two Years since, the Speck has gradually decreased, and is now so small, that it is scarce visible; and her Sight is as perfect and strong as before this Accident.

Thomas Baker, Surgeon.

VIII. *Extract of a Letter dated at Montpelier, Dec. 27. 1731. N. S. from Andrew Cantwell, M. D. Monspel. to T. S. M. D. and by him translated from the French, giving an Account of a monstrous Boy.*

THERE is actually in this Town, a Lad of thirteen Years of Age, born at *Cremona*, who bears the lower Parts of another Boy, which seem to issue from his Epigastric Region, between the *Cartilago ensiformis* and the Navel. The Fore-part of the one faces that of the other. The Head and Trunk seem buried in the Lad's *Abdomen*, down to the Hips, where the Connection is plainly to be seen. This Portion of the prominent Body has a well-form'd *Anus* and *Penis*. The *Scrotum* has a fine Down on it, but is void of Testicles, and seems to be filled with the Intestines. Nothing passes through these two Outlets. I have perfectly well distinguished the two *Ossa Ilium* in their natural State, but could not feel the *Os Sacrum*. The Articulation of the *Femur* is somewhat discernible on each Side: and I have perceived the Pulsation of the anterior crural Arteries. The Lad is very sensible when these additional Feet, Legs, or Buttocks, are pinched, or over-much pressed. He has lately had the Small-pox, and these have suffered by it equally with him. At his Navel I found a considerable Rupture, which is covered by this Portion of a Body. This Rupture grows monstrously big in wet Weather, and diminishes again in
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dry. It has a circular Hole in it, which runs through the *Peritonæum*. The Lad is of a thin Habit of Body, but otherwise enjoys good Health. His Father, *Michael Martinetti*, a Tinker, told me, that this is the seventh Child his Wife *Nunciada* bore him. She was thirty Years of Age at his Birth, and bore him two more since. All the rest were of the natural Shape.

IX. *Three extraordinary Cases in Surgery, by Bezaleel Sherman, Surgeon, at Kelvedon in Essex, communicated in November 1738.*

SAMUEL Bush, of the Parish of *Wickham-Bishops*, in *September 1704*. being on the Top of a very high Timber Tree, in order to shake down the Acorns, he let go his Hold; and by falling from one Bough of the Tree upon another, he broke his Thigh-bone; and one End of it, by the Force of the Fall, stuck fast in the Ground, which fractured the Bone in another Place, about two Inches and an half above the former. This intire Piece of the *Os Femoris* was taken out; notwithstanding which, so large a *Callus* united the two Ends of the Bone, that his Thigh (when cured) was very little more than a quarter of an Inch shorter than the other Thigh. The Surgeon who had the Care of him, used his greatest Endeavours, during the Cure, to preserve the Extension; but he imputed the Largeness of the *Callus* to a very great Quantity of *Lap. Osteocolla*, which he made him take for six Weeks or two Months, in Powder with Milk,
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in an Electuary, in his Bread, and in his Pudding ; in short, in almost all the Food he took.—

— *Fitch*, of the Parish of *Keldon*, had a foul Ulcer in his Mouth, with a *Caries* in the lower Jaw-bone, one Part of which, from the Suture at the Chin to the End of it under the Ear, in Process of Time intirely came out, with three Teeth in it. This was also owing to a great Quantity of *Osteocolla* internally given, which was thought not only to expedite this large Exfoliation, but at the same time to generate so large and firm a *Callus*, that he can chew an hard Crust, or any other Food, on that Side as well as on the other.—

John Spilman, Bricklayer, of *Maldon*, came to me the 3d of *October* 1734. having a sinuous Ulcer in his *Rectum*, about two Inches from the *Anus*. This had remained a Twelvemonth, and was taken for the Piles, and treated as such, both internally and externally. I soon perceived a Tumour in his Buttock two or three Inches from the *Anus*, which coming to Suppuration, I opened it by Incision ; and after dressing it several Weeks with little Prospect of Success, I discovered at the Bottom of the Ulcer something that looked like a Bone, which when extracted, proved to be the lower Jaw of a Fish, as a *Whiting*, or young *Cod*, &c. And unquestionably this was swallowed at least a Year before it came away, because the pricking Pain he felt when the sharp End of the Bone stuck in the *Rectum*, was the Symptom mistaken for the Piles ; and when this had made its Way thro' the *Rectum*, and got into the fleshy Part, the Aposthume followed in course ; and the Bone being ex-

tracted, the Ulcer was soon cicatrized by the common Methods of Cure in such Cases.

N.B. All these Persons are yet living, and will attest the Truth of the Case.

X. *A Letter from Tho. Stack, M. D. to Sir Hans Sloane, Bart. Pr. R. S. &c. containing an Account of a Woman sixty-eight Years of Age, who gave Suck to two of her Grand-children.*

Honoured S I R,

A Gentleman of Credit having lately inform'd me of a Woman near seventy Years old, who actually suckles one of her Grand-children, and courteously offering to accompany me to her, excited my Curiosity to see so uncommon a Sight; and the more, in order to try if I could not discover some Fallacy in the Affair. Wherefore I went Yesterday, in Company with the aforefaid Gentleman, to a House in *Tottenham-Court-Road*, where the Woman we inquired for appear'd in an Instant. Her Breasts were full, fair, and void of Wrinkles; though her Face is very much wither'd, her Cheeks and Mouth vastly sunk in, her Eyes red, and running with a clammy Humour; and though she has, in short, all the other external Marks that one may reasonably expect to find in a Woman, who has spent the last Half of her past Life in Labour, Troubles, and other Concomitants of Poverty, and through them has reach'd near to her

70th Year. Upon pressing her right Breast, she fairly squeez'd out Milk, which gather'd in small Drops at three of the Lactcal Ducts terminating in the Nipple. This Experiment I made her repeat a second time, having myself carefully dry'd the End of the Nipple with my Handkerchief, as I had done before her first Trial. Convinced of the Truth of the Fact, I ask'd her several Questions, in order to procure Materials for a History thereof. The Substance of her Answers was as follows :

Her Name by Marriage is *Elizabeth Brian*. She is in the sixty-eighth Year of her Age since last *October*, and has not borne a Child these twenty Years and upwards. About four Years since, her Daughter being obliged to leave an Infant she then gave Suck to, in the Care of this her own Mother, and likely to be a considerable time absent ; the old Woman, finding the Child froward for want of the Breast, apply'd it to her own, barely in order to quiet the Infant, without the least Thoughts of Milk. And this having reiterated several times, a Son of hers, by that time grown a Man, perceiv'd that the Child seem'd to swallow somewhat from the Nipple ; whereupon he begg'd Leave of his Mother to try if she had not Milk. The Experiment succeeded : The Youth drew Milk from that same Breast from which he had been wean'd above twenty Years, and which had been unaccustom'd to any for seventeen or eighteen Years before : The good Woman then continued to suckle her Grand-child in earnest : And in some time her Daughter, *viz.* the Infant's Mother, seeing she was provided with such an extraordinary and tender Nurse, was embolden'd to bid fair for an Increase of Issue, which

which till then she knew not how to nourish or provide for. Accordingly, at the End of two Years, she brought forth another Child; whereupon the Grandmother wean'd the first, and suckled the latter; which she has done these last two Years, and still continues to do. And this Infant, in my Presence, took the Nipple with as much Eagerness, and seeming Delight, as I ever perceived in a Child of two Years old; and at it plainly perform'd the Actions of Suction and Deglutition. The two Children, both Girls, are, as to Constitution, such as I could wish to the dearest Friend; plump and firm in Flesh; in Complexion cleanly, fair and healthy, and in Temper brisk and sprightly; considering the Lowness of their Condition and Education, and the mean Diet of the Nurse.

When this good Woman came to Town, which was near two Years since, her Milk abounded to that Degree in both Breasts, that, to convince the Unbelieving, she would frequently spout it above a Yard from her: A Particular which, among others, the good Man and Woman of the House, and others of the Neighbourhood, likewise assured me of. Now her left Breast is run dry, and she has no great Quantity in the Right: But what there is, is as good Milk as one may desire in a Nurse.

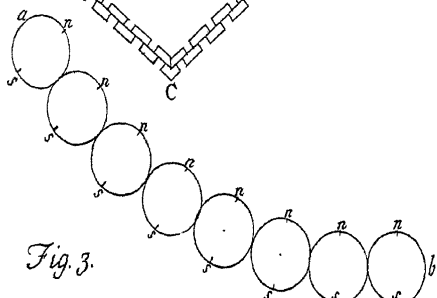
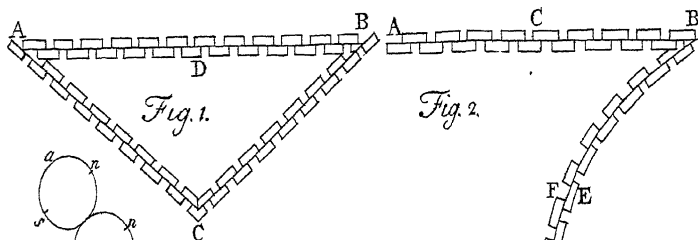
The poor Woman seems perfectly honest and artless, and even inclines strongly to Dotage. She very religiously throws the Whole upon a Miracle.

I beg Leave to subscribe with Gratitude and Respect,
both in a supreme Degree, *Honoured S I R,*

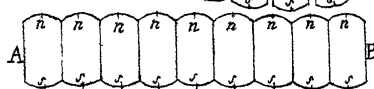
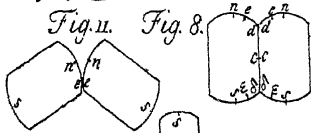
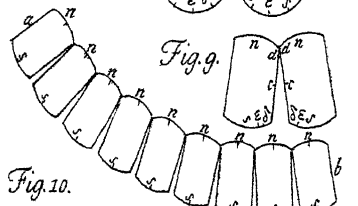
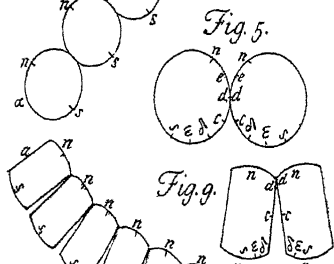
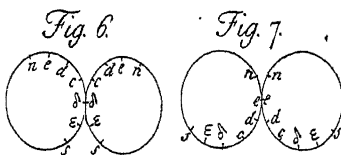
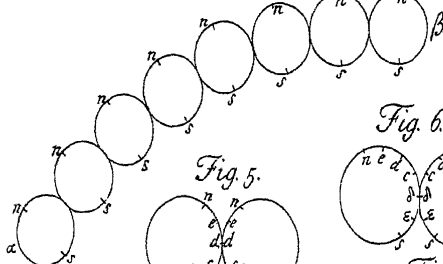
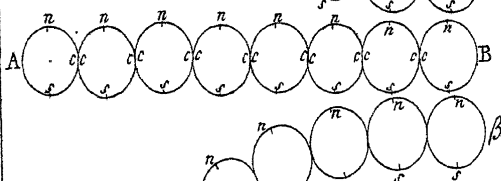
*London, Jan. 8.
1733. St. Jul.*

*Your most obliged
and obedient Servant,*

Thomas Stack.



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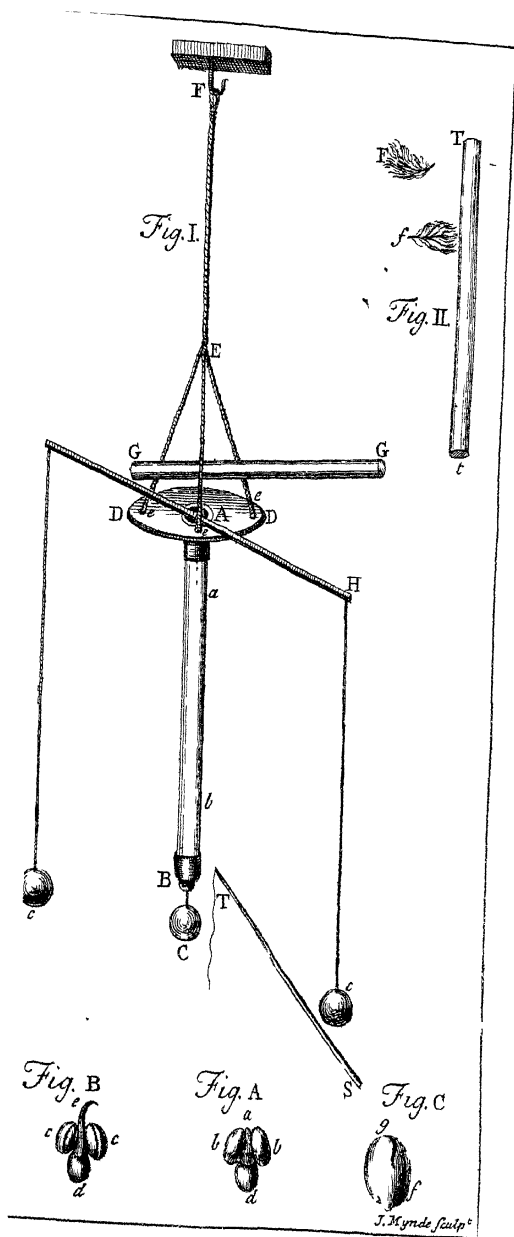
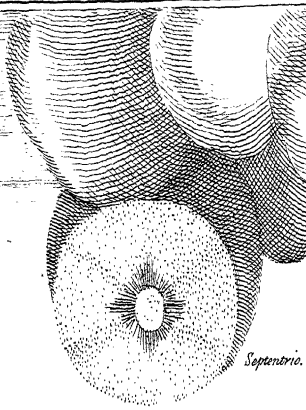
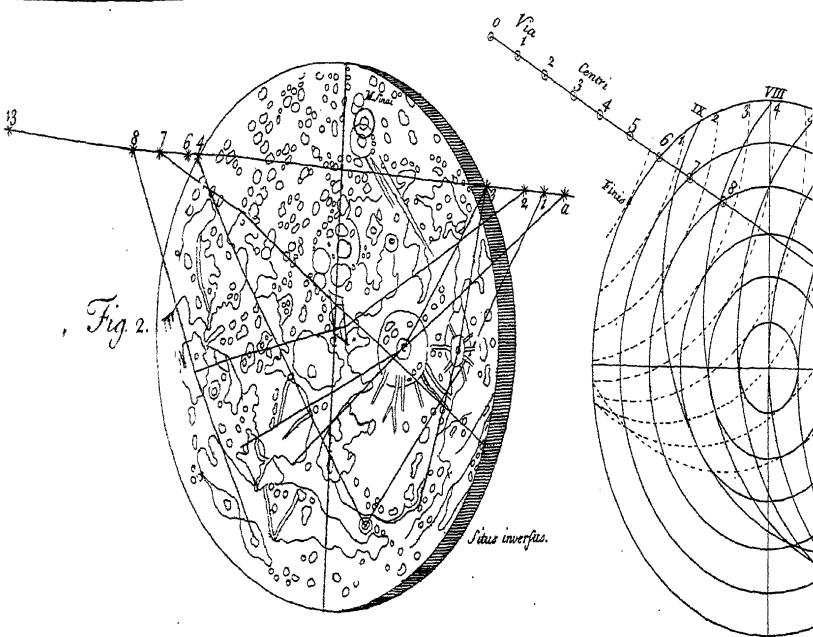




Fig. 1.



Septentrio.



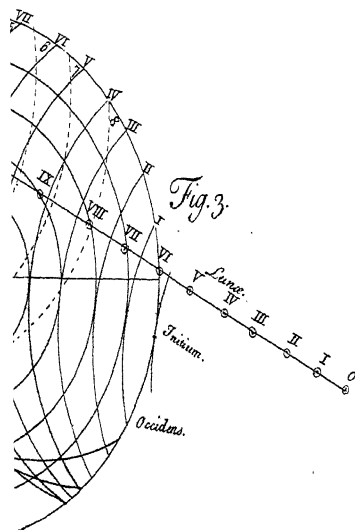
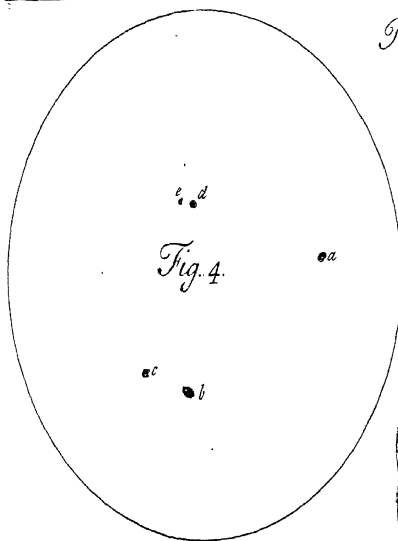
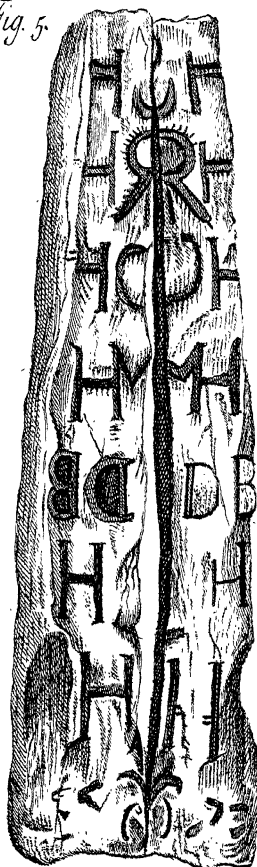


Fig. 5.



PHILOSOPHICAL TRANSACTIONS.

For the Months of *July, August, September,*
and *October, 1739.*

The CONTENTS.

- I. *A Letter from the Rev. Mr. John Clayton (afterwards Dean of Kildare in Ireland) to Dr. Grew, in Answer to several Queries relating to Virginia, sent to him by that learned Gentleman, A. D. 1687. communicated by the Right Reverend Father in God Robert Lord Bishop of Corke, to John Earl of Egmont, F. R. S.*
- II. *An Experiment to prove, that Water, when agitated by Fire, is infinitely more elastic than Air in the same Circumstances; by the late Rev. John Clayton, Dean of Kildare in Ireland. Communicated by the same Hand as the preceding.*
- III. *Part of a Letter from John Green, M. D. Secretary of the Gentlemens Society at Spalding in Lincolnshire, to C. Mortimer, M. D. Sec. R. S. serving to inclose a Relation of a Girl three Years old, who remained a Quarter of an Hour under Water without Drowning.*
- IV. *The Case of Mr. T. Cox, Surgeon at Peterborough, who fell into a Pestilential Fever, upon Tapping a Corpse lately dead of an Hydropsy, drawn up by himself, and read before the Peterborough Society, Sept. 1. 1736. communicated to the ROYAL SOCIETY by the Rev. Mr. Tim. Neve, Secretary to the Peterborough Society.*
- V. *The Variation of the Magnetic Needle, as observed in Three Voyages from London to Maryland, by Walter Hoxton, Gent.*
- VI. *Some Thoughts and Conjectures concerning the Cause of Elasticity, by J. T. Desaguliers, LL. D. F. R. S.*
- VII. *Some*

The CONTENTS.

- VII. *Some Thoughts and Experiments concerning Electricity*, by J. T. Desaguliers, LL. D. F. R. S.
- VIII. EXPERIMENTS made before the ROYAL SOCIETY, Feb. 2. 1737-8. by the Same.
- IX. *An Account of some Electrical Experiments made before the ROYAL SOCIETY on Thursday the 16th of February 1737-8. By the Same.*
- X. *An Account of some Electrical Experiments made at his ROYAL HIGHNESS the PRINCE of WALES's House at Cliefden, on Tuesday the 15th of April 1738. where the Electricity was conveyed 420 Feet in a strait Line. By the Same.*
- XI. *Observationes Botanicæ, Plantarum quarundam Descriptiones accuratiores exhibentes; per Dn. Paulum Henricum Gerhardum Mœhring, M. D. factæ; ad Illustrissimum Dn. Hans Sloane, Bart. R. S. Præf. missæ.*
- XII. *Observatio Anthelii Vitembergæ spectati; per J. Frid. Weidlerum Mathes. Prof. ibidem Primar. & R. S. Lond. Soc. communicata in Epistola ad C. Mortimerum, R. S. Secr.*
- XIII. *Occultatio Palilicii A. 1738. d. 23. Decembris, St. N. observata a D. Christfried Kirchio, Astronomo Regio Berolini; ex literis ad J. F. Weidlerum, datis excerpta.*
- XIV. *Eclipsis Solis observata Vitembergæ Saxonum D. iv. Aug. St. N. d. xxiv. Julii St. Vet. A. MDCCXXXIX, post. merid. a Jo. Friderico Weidlero, R. S. Lond. S.*
- XV. *Part of a Letter from Mr. J. Derby to Mr. Henry Sheppard, concerning a terrible Whirl-wind, which happen'd at Corne-Abbas in Dorsetshire, Oct. 30. 1731. communicated to the ROYAL SOCIETY by Edmund Halley, LL. D. V. Pr. R. S. and Astronom. Reg.*
- XVI. *An Account of Letters found in the Middle of a Beech, by J. Theod. Klein, Secretary of Dantzick, F. R. S. Oct. 19. 1729. communicated to the ROYAL SOCIETY by Sir Hans Sloane, Bart. Pr. of the R. S. and Physician to His MAJESTY, &c. Translated from the Latin by T. S. M. D.*
- XVII. *Part of a Letter from Sir John Clark, one of the Barons of His MAJESTY's Exchequer in Scotland, and F. R. S. to Rog. Gale, Esq; Tr. R. S.* I. A

- I. *A Letter from the Rev^d Mr. John Clayton, (afterwards Dean of Kildare in Ireland) to Dr. Grew, in Answer to several Queries relating to Virginia, sent to him by that learned Gentleman, A. D. 1687. * communicated by the Right Revernd Father in God Robert Lord Bishop of Corke, to John Earl of Egmont, F. R. S.*

— I Have observed many gross Mistakes in Peoples Notions of *Virginia*, when discoursing of the Natives, which have risen from the want of making a Distinction in their Expressions, when they speak of the *English* or *Whites*, born there, and so called *Natives*; and the *Aborigines* of the Country. Please therefore to take Notice, that when I speak of the Natives in general, I mean only the *Indians*.

As therefore to your first Query: Their *Witchist*, that is, their Priest, is generally their Physician; and is a Person of the greatest Honour and Esteem among them, next to the King, or to their great War Captain.

2. Nature is their great Apothecary, each Physician furnishing himself, according to his Skill, with Herbs, or the Leaves, Fruit, Roots, or Barks of Trees; of which he sometimes makes use of the Juice, and sometimes reduces them into Powder, or perhaps makes a Decoction thereof.

3. Though every one, according to his Skill, is a sort of Doctor, (as many Women are in *England*)

* This may serve as a Sequel to the Accounts of *Virginia* formerly given by Mr. Clayton. See these *Transactions*, N^o 201. 205. 206. 210

get their Priest is peculiarly styled their Physician, to be consulted upon greater Emergencies. The Rules of the Descent hereof, as to Families, I do not know ; for they are a fullen close People, and will answer very few Questions.

4. They reward their Physician with no certain Fees, but according as they bargain for *Wampaupeake* Skins, or the like. If it be to an *Englishman* they are sent for, they will agree for a Match-coat, a Gallon or two of Rum, or so-forth, according to the Nature of the Cure. Sometimes the Priest will sell his Remedy ; for some of them have told me, that they have bought the Root which cures the Bite of the Rattle-snake from their *Wiotchist*.

5. Their King allows no Salary, that ever I heard of ; but every one that in any Nature can serve his Prince, is ready to do it, and to do it *gratis*.

6. They have no Consultations, their Practice being merely empirical. They know little of the Nature or Reason of Things. Ask them any Question about the Operation of a Remedy, and, if in good Humour, perhaps they will reply, *It cures* ; otherwise, they will shrug their Shoulders, and you may ask forty Questions, and not know whether they understand either the Thing, or what it is that you say to them.

7. They pay a certain Deference of Honour to their Priest or *Wiotchist*, whose Person they hold sacred ; but Laws they have none (as far as I could ever learn) that binds them thereto : In general, the Will of their Prince stands for Reason and Law.

8. The Means whereby they convey their Art to Posterity, I take to be this : They lodge in their *Wiotchisan*

Wiochisan Houses, *i. e.* their Temples, certain kinds of Reliques, such as Mens Skulls, some certain Grains or Pulse, and several Herbs, which are dedicated to their Gods; *viz.* The Skulls in Memory of their Fights and Conquests; the Pulse by way of Thank-offering for their Provisions; and the Herbs upon the same Account, for some special Cure performed thereby. For when any one is cured by any Herb, he brings Part thereof, and offers it to his God; whereby the Remembrance of this Herb and its Virtue is not only preserved, but the Priest also becomes best instructed thereby, and knowing in the Art of Medicine: For otherwise, they are mighty reserved of their Knowledge, even among themselves. Whether the Priest takes certain Persons to instruct, or teaches only his own Children, I know not. Often when they are abroad hunting in the Woods, and fall sick, or come by any Hurt, they then are forced to make use of any Herbs which are nearest at Hand, which they are not timorous in venturing upon, though they know not the Virtue or Qualities thereof. And thus, by making many Trials and Experiments, they find out the Virtues of Herbs; and by using simple Remedies, they certainly know what it is that effects the Cure.

9. They are generally most famed for curing of Wounds, and have indeed various very good Wound-herbs, as an Herb commonly called *Indian-weed*, which perhaps may be referred to the *Valerians*, and be said to be *Platani foliis*. They use also the *Gnaphalium Americanum*, commonly called there *White Plantain*. As to our *Plantain*, or the *Heptapleuron*, they call it the *Englishman's-foot*, and have a Tradition,

dition, that it will only grow where they have trodden, and was never known before the *English* came into this Country. The most famous old Physician among the *Apomatick Indians*, as I was informed by a Person of a very good Understanding, used mostly an Herb which he shewed me, whose Leaf is much like *Self-heal* in Winter. I observed it was red underneath, and would at length appear tinged on the upper Side also: It makes a good Salve, only it fills a Wound too fast with Flesh. I took a Draught of this Herb, along with some others, which I have left in the North of *England*. The great Success they have in curing Wounds and Sores, I apprehend mostly to proceed from their Manner of dressing them: For they first cleanse them, by Sucking, which, though a very nasty, is, no doubt, the most effectual and best way imaginable; then they take the *biting Persicary*, and chew it in their Mouths, and thence squirt the Juice thereof into the Wound, which they will do as if it were out of a Syringe. Then they apply their Salve-herbs, either bruised or beaten into a Salve with Grease, binding it on with Bark and Silk-grass. Colonel *Spencer*, the present Secretary of State of *Virginia*, told me of a very strange and extraordinary Cure performed by an *Indian*, on one of his *Negraes*. The *Negro* was a very good Servant, wherefore his Master had valued him much; but by Degrees he grew dim-sighted, and was troubled with terrible Pains in his Eyes, so that with one he could see but a little, and none at all with the other; and as the Pain still increased, the Colonel was greatly apprehensive, lest his *Negro* would be quite blind. Several Surgeons were sent for,

for, who had tried to cure him, but in vain ; when an *Indian*, coming to the House, said he would cure him ; they told Mr. Secretary thereof, who sent for the *Indian*, and agreed with him for two Quarts of Rum. The *Indian* told him, that he could save one Eye, but that the *Negro* would be blind of the other. The next Morning the *Indian* went a hunting into the Woods for his Herbs, and returned with them about Noon, which he bruised, putting thereto a little Water ; and having pressed forth some of the Juice, he dropped some thereof into the Eye which he said would be blind, and laid the Herbs thereon, which he would have bound fast with Bark ; but the Colonel called for some Linen Rags, and had it bound up therewith. He then intimated to the Colonel, that shortly after Sun-set the *Negro* would be mad, if his Medicine took Effect, but would come to himself again before Morning ; wherefore strict Orders were given, that he should be well attended, and that nothing should be altered, let what would happen. All things therefore being accordingly done as the *Indian* had directed, every thing succeeded likewise as the *Indian* had foretold. Then, about 11 o'Clock the next Day, the Binding being removed, and the Herbs taken off from the Eye, the *Indian* bid the *Negro* hold down his Head, which when he had done, out-dropped the Crystalline and aqueous Humours. The *Indian* afterwards bound it up again, and by Degrees the *Negro* was freed from his Pain, and had perfect Sight with the other Eye. What the Herbs were, the Colonel could never learn from him, though he proffered him whatever he would demand.

10. The Distempers amongst the *English* Natives (for I cannot give so particular an Account of the Distempers most predominant among the *Indians*) are, *Scorbutical Dropsies*, *Cachexies*, *Lethargies*, *Seasonings*, which are an intermitting Fever, or rather a continued Fever with quotidian Paroxysms. These are now rarely sharp, but shew themselves in a lingering Sickness. The *Gripping of the Guts* mostly dry, and when the *Tormina Ventris* cease, they generally shoot into the Limbs, and fix there, in a terrible sort of Gout, taking away the Use of the Limbs. Thus they will pine away to Skin and Bone, so that their Joints will seem dislocated, and their Hands utterly crippled. *Sore Throats*, which the last Year were very frequent, and deemed infectious, running generally through whole Families, and, unless early prevented, became a cancerous Humour, and had Effects like the *French-pox*. Likewise *Pains in the Limbs*, which I apprehend to have proceeded partly from the same Humour floating up and down the Body. These Pains are very exquisite, mostly nocturnal; for while they walk, if they have the Use of their Limbs, they feel the least Pain. The Oil of a Fish called a *Drum*, was found very effectual to cure these Pains, and restore the Limbs. I was Eye-witness when a very worthy Gentlewoman, who had lost the Use of her Limbs, was intirely recover'd by the Use of this Medicine: For her Feet being anointed with this Oil, the Pains flew into her Head; her Head thereupon being anointed, the Pain descended again; then anointing both Head and Feet, she was recover'd. There are three sorts of Oils in that Country, whose Virtues, if fully proved, might
not

not perhaps be found despicable : The Oil of *Drums*, the Oil of *Rattle-snakes*, and the Oil of *Turkey-Bustards*. The Oil of *Sassafras-leaves* may be deservedly consider'd too, for they will almost intirely dissolve into an Oil. But to return : There is another sort of Distemper, which I judge to be the *Lepra Græcorum*. And it may perhaps be no bad Conjecture, that this chiefly proceeds from their feeding so much as they do, on a delicate luscious sort of Pork. Among the *Indians* they have a Distemper which they call the *Taws*, which is nearly related to the *French-pox*; which they are said to cure with an Herb that fluxes them : But this I have only by Hear-say.

11. The *Indians* mind neither the Pulse nor Urine, only judge by the common most remarkable Symptoms; and some pretend to form a Judgment from the Countenance, and are fond of being thought Physiognomists.

12. I never could find, that they practised the *letting of Blood*. They purge much with several sorts of Roots of their own Country Growth, and vomit frequently with various Herbs. They sweat boldly and excessively, and after a very strange manner : For they have their Sweating-stoves always upon the Bank of some River; whence they rush forth in the Height of their Sweat, and run into the River, where they wash and bathe themselves very plentifully. They use no *Blistering-plasters*, but are exquisite at Cupping. As the *East-Indians* use *Moxa*, so these burn with *Punk*, which is the inward Part of the Excrecence or Exuberance of an *Oak*. When they design to give a *Purge*, they make use of the following

ing Herbs: *Poake-root*, i. e. *Solanum bacciferum*, a strong Purge, and by most deemed Poison. The Roots of *Tythimal*, of which I have observed two sorts; the one *Flore minimo herbaceo*, the other *Flore albo*. The Flower of this last is small, but large in Comparison with the other: They are *repentes*, and grow in old manured Grounds. They chiefly make use of the latter of these, and it is a most excellent Purge, though it sometimes vomits: It is a quick, but moderate Worker enough; and has this Peculiarity, that it opens the Body in the *Gripes*, when other much violenter Purgatives will not move it. There is another Herb, which they call the *Indian Purge*: This Plant has several woody Stalks growing near three Feet tall, and, as I remember, *perfoliat*: It bears yellow Berries round about the Joints: They only make use of the Root of this Plant. They use also the *small Fleur de Lis*, whose Virtues, I believe, are not yet half known, for it has some extraordinary Qualities: It does not grow above a Hand high, flowers in *March*, and is very fragrant. They use also some sort of the *Apocynum's*; particularly that which I think *Gerard* calls *Vincetoxicum Americanum*; for there are several sorts of *Apocynum's*, I think 13 or 14, but they are not all purgative: For having got some of the Root from an *Indian*, which he assured me was the *Rattle-snake-root*, I thought the Root of an *Apocynum* (which may well be distinguished by that of *Rosæ Mariæ foliis*) was very like it, both in Shape and Taste, considering the one dried, and the other fresh: Wherefore I got some Quantity thereof, and carrying it in my Pocket, I ventured to eat thereof, little
by

by little, till I believe I have taken a Drachm at a time, to observe if it had any peculiar Operation on the Body; but could never find, that it had.

They have likewise several sorts of Herbs, where-with they vomit; one of which is a little sort of *Squills*. They likewise take the Leaves of a certain curious odoriferous Shrub, that grows in the Swamps, which I take to be the *lesser Sassafras*; they bruise them in Water, and then express the Juice, which they drink warm. The *Indian* Interpreter, who taught me this, prized it much, as excellent Physic, and said they found it a very sovereign Remedy. It is as odoriferous as any Shrub I ever smelt at in my Life: Whoever has once taken Notice of the Smell, cannot forget it, or be deceived therein afterwards, having something peculiar in it. The Name which the *Indian* gave me hereof was *Wisochis*, which since I understand is the general Word for Physic.

13. The rest of their *Materia Medica* consists of Herbs, of which they have great Plenty, and seldom prescribe any thing else. I have collected above 300 several sorts, that were no *European* Plants; but I shall only mention those at present, whose Virtues I take to be most remarkable. And first, the *Sassafras-tree*, whose Root is well enough known. It shoots forth its Blossoms in *March*, which are yellow, and grow in little Bunches like Grape-flowers, and which, when gathered and picked from the husky Bud, make a curious Preserve. Most *Sassafras-trees* blossom, few bear Berries, but those that do are generally very thick: They are shaped much like those of *Dulcamara*, but are black of Colour, and very aromatic; I take them to have considerable Virtues.

The *Gum-tree*, which I refer to the Species of Planetrees, and distinguish it by its Fig-like Leaf, only more sharply dented. Its Leaf smells much like a Lemon. Their Practice is to beat the Tree, and then pill off the Bark, and so scrape the Gum, which has Virtues like Turpentine, or rather more astringent and drying. This they usually mix with their common Turpentine, which is whiter and more Butter-like, than the *Venice* or *Chios* Turpentine. *Quere*, whether better or no? The further Method of preparing this Medicine, as I am told, is this: They expose it to the Sun on Paper, where at first it rather seems to melt, but it will afterwards grow hard; they then beat it to a Powder, and administer it. They use much the young Buds of the *Populus*, *sive Tulippa arbor*, a vast large Tree, extraordinary spacious, bearing Flowers about *April*, much like Tulips; its Leaves are large, smooth, and well-shaped, which, together with the Flowers, render the Tree exceeding beautiful to behold. It bears its Seed coniferous, and is an excellent Opener of Obstructions. The *Sorrel-tree* bears a Leaf something like a Laurel, in Taste much resembling *Luzula*. They use it in Fevers, and, as I am informed, with good Success. This Tree grows plentifully on the South-side of *James River* in *Virginia*; I cannot say I ever found it to the Northward. The *Swamp-plum-tree*, whose Wood they calcine, and make into Charcoal, which they beat to a Powder, then mix it with Grease, and make an Ointment thereof, with which they anoint the Body, and foment it very much, whereby they cure the *Dropsy*; for it opens the Pores to that Degree, that the Water runs down their Legs. Among
their

their Herbs, I have had 40 several Sorts, or near that Number, shewed me as great Secrets, for the *Rattle-snake-root*, or that kind of *Snake-root* which is good for curing the Bite of the *Rattle-snake*: But I have no Reason to believe, that any of them are able to effect the Cure. One Gentleman shewed me a certain Root, which was a *Smilax*, and assured me, that that was certainly the *Rattle-snake-root*. And afterwards, when I shewed Mr. Secretary *Spencer* the same Root, he said that certain *Indians* had given him of the same Root for the *Rattle-snake-root*, and that he had some Quantity to send for *England*; but this Root is by no means the same with that which I have mentioned before, in Answer to *Quære* 12. which I said was like the Root of an *Apocynum*, which I myself obtained from an *Indian*, who seemed to prize it highly, having sewed it carefully up in Leather, on the Inside of his Belt. Others have shewed me *Chrysanthemum ferulaceis foliis* for it; others *Chrysanthemum tragopyri foliis*. Again; general Report goes in favour of the *Asarum Cyclaminis foliis*, which many therefore particularly call *Rattle-snake-root*. There are strange Stories told in favour of an Herb called *Dittany*, which however is not of the *Dittany* kind, but is only a Mountain *Calaminth*. This, they say, will not only cure the Bite of a *Rattle-snake*, but that the Smell thereof will kill the *Snake*. But however, * I have some Reason to believe, that this Herb will not cure the Bite, nor that the Smell thereof will kill the

* See *Miscel. Curiosa*, Vol. III. p. 352.

Snake; for Colonel *Spencer* assured me, that he had an Opportunity of making an Experiment thereof upon a Dog which was bitten by a *Rattle-snake*, to which he gave plentifully of the Juice of his *Dittany*, as they called it; but the Dog died nevertheless a Day or two after. And Mr. *Wormley*, one of the Council of State in *Virginia*, told me, that being in Company with another Gentleman, he had an Opportunity of making the following Experiment; for seeing a *Rattle-snake* in her Coil, they went and got a Bunch of this *Dittany*, and tied it to a Pole; then putting the *Dittany* that was thereon to the Nose of the *Snake*, it seemed to offend her, whereupon she turned away her Head, which they still followed with the *Dittany*; then the *Snake* fled, and they still pursuing her, she at last stretched herself out at Length, and lay seemingly dead. Then they laid the *Dittany* upon her Head, and went into a neighbouring House to refresh themselves; for they were tired with skipping about after the *Snake*. When they had staid near half an Hour, they returned to see their supposed dead *Snake*; but, behold! the *Snake* was fled; so that they then judged, that the *Snake* had only stretched herself out, because she had been tired with their Pursuit. I look upon it probable therefore, that some Accident of the like kind may have first given Origin to this Story; the Person who had tired the *Snake* not having regularly waited for the Event, but perhaps, to secure the Conquest, may have given the *Snake* a Stroke with a Switch upon the Back (which would have killed the *Snake* without the *Dittany*). But yet nevertheless, this Plant is of more than ordinary Virtues, and might not unprofitably

ably be used by our Physicians. It may be referred to the Class of the *Calamintha montana*, *pulegii odore*, which has been transferred from thence into *England*, and I think is now pretty common, but is hotter, and more sudorific.

I will now mention to you an Herb, though unknown, yet worthy to be fetched from *Virginia*, yielded the Country nothing else: It is the Herb called there *Angelica*, but which I take to be *Libanotis vera latifolia Dodonæi*. It grows generally on a rich sandy Ground, on a declining Brow, that faces the rising Sun; the Root shoots deep into the Earth, sometimes near three Feet, very tender, and easily broken, of a white or rather Cream-like Colour; and being lactescent, yields a little Milk, thick and yellow as Cream; a very early Plant. It seldom flowers or seeds under five Years Growth; for I have fully and distinctly observed that Number of Years in the several Sorts of this Plant, by the Growth of those not come to Maturity to bear Seed; and it is observable, that those which do not seed, have rarely more than one Branch, which divides when it spreads, and subdivides itself still into Three. The Leaf is much like our wild *Angelica*, only thinner, and more the Colour of a Willow-green. Those that seed, have a fistulous Stalk about the Thickness of *Dill*, a white umbelliferous Plant; the Seeds are much like *Angelica seed*, but from the Fragrancy of the Root, and its being peculiarly bearded, I undoubtedly style it a *Libanotis*. It stops the *Flux*, and cures it, to a Wonder. Again; it often loosens and purges the Bodies of those that are bound, and have the Gripes, especially if it proceeds from Cold; and prevents many
unhappy

unhappy Distempers. I have Reason to speak well of it; for it is to it, under GOD, that I attribute the saving of my own Life. I have known it give 14 or 15 Stools, whereas it will not move a Child in Health. I take it to be the most sovereign Remedy the World ever knew in the Griping of the Guts, and admirable against Vapours. It is sudorific, and very aromatic, and will not be concealed; for wherever it is mixed, it will have the predominant Scent. It is mostly called by those who know it in *Virginia*, by the Name of *Angelica*: But shewing a Piece of the Root to a great Woodsman, to see whether he knew it, and could tell me where it grew, he seemed surpris'd to see me have thereof; and told me, that he kept an *Indian* once for some Weeks with him, because he was an excellent Woodsman, and going a hunting, (*i. e.*) shooting, they came where some of this Root grew: The *Indian*, rejoicing, gather'd some of it, but was very careful to cut off the Top of the Root, and replant it: He then asked him, Why he was so careful? Whereunto the *Indian* replied, It was a very choice Plant, and very scarce; for they sometimes travelled 100 or 200 Miles without finding any of it. He then asked him, What Use it was of? To which the *Indian* answered, You shall see by-and-by. After some time, they spied four Deer at a Distance; then the *Indian*, contrary to his usual Custom, went to Windward of them, and sitting down upon an old Trunk of a Tree, began to rub the Root betwixt his Hands; at which the Deer tossed up their Heads, and snuffing with their Noses, they fed towards the Place where the *Indian* sat, till they came within easy Shot of him; whereupon he fired at them, and killed a
large

large Buck. The Truth of this Story I no further assert, than that I was told it by a Person of seeming Seriousness, who had no Inducement to tell a Lye, or impose upon me: But I have often taken Notice, that the *Indians* smell generally strong of this Herb. And I have since learned from others, that the *Indians* call it the *Hunting-root*, which makes me more inclinable to give Credence to this Story. Another Gentleman, a white Native of that Country, when I once pulled a Piece of the Root out of my Pocket to bite thereof, (for I frequently carried some of it about me) asked me, If I loved Fishing? I required, Wherefore he asked me that Question? Because, said he, you have gotten some of the *Fishing-root*. The *Fishing-root*! replied I; pray why do you give it that Name? Because, said he, when we were Boys, we used to get some of it to lay with our Baits to invite the Fish to bite. This I can say of my own Knowledge, that having one Day got some Quantity of the Root, and likewise of the Branches, to distil, the strong Scent, as I went home, palpably put me into a breathing Sweat. In the Night I was waked by a Rat, which ran over my Face, whereas I never at any other time had the like happen to me; but will not be positive to conclude, that this Root was the Cause thereof, only the precedent Relations made me reflect thereon. There is another Root of the Species of *Hyacinths*, the Leaves whereof are grass-like, but smooth and stiff, of a willow-green Colour, and spread like a Star upon the Ground; from the Middle shoots a tall long rush-like Stem, without Leaves, near two Feet high; on one Side grow little white Bell-flowers one above another: The Root is
black

black outwardly, but brown within. It is bitter, and I take it to have much the same Virtues as *Little Centaury*. Some call it *Ague-grass*, others *Ague-root*, others *Star-grass*. I have likewise been told by several, of a Root which the *Indians* cure Bruises wonderfully with; but I apprehend it is the same Root with which the *Indian* cured the *Negro's* Eye afore-mentioned; for it operates much after the same manner, according to their Relation, making the Patients mad for some Hours, if they be recoverable. It is not to be applied where the Skin is broken. They use it thus: They chew some of the Root in their Mouths, and then squirt it forth on the bruised Part, fomenting it well with their Hands; then they give a little to the Person bruised to chew, who must swallow the Juice, but spit forth the Root again, which they bind on the Part aggrieved. If the Relations I have had of Cures performed thereby, be absolutely true, the World has not yet discovered a more wonderful Remedy. I had it described to me by Colonel *Smith*, of the *Isle of Wight County*, to be like *Langue de Bœuf*, with a yellow Flower, and rough hoary Leaf, the Root yellowish, and tasted something sweetish like Liquorice. There are several others I might name, whose Virtues are by no means despicable; such as the *Chrysanthemum platani foliis*, whose Root is very useful in *old Pains*, the *Sciatica* and *Gout*. It is a large Herb, grows betwixt five and six Feet tall. There are likewise many others, which bear some Analogy to the *European* Plants, such as *Solomon's-seal*, *Wood-sage*, much better, I think, than the *English*; which the *Indians* use much for Infusions, and which they take as we do Diet-drink.

drink. *Little-Centauray*, red, white, and yellow, &c. However, I never could find above 12 or 14 Plants, which were Natives of that Country, that agreed perfectly with any of our *European* Plants, but what had some notable Differences, if they were not rather to be reckoned a distinct Genus.

13. There go Traditions of their having an Art to poison their Darts; but I could never find any solid Grounds for that Report. I have observed, that in those Countries, upon an ill Habit of Body, the least Scratch is dangerous; and that, for all the Care that can be taken to prevent it, it often turns into a very desperate ulcerous Sore. Some Herbs there are of an analogous Nature with *Hemlock*, whereof, I think, they know nothing further, than that they are to avoid them; but any Herbs, wherewith they poison their Darts, I never could hear specified. And as Persons engaged in long Marches are liable to many Accidents, which may contribute to an ill State of Health, when a slight Wound in Battle has then proved mortal; this I apprehend to have been the Cause, why the Physician has rather chosen to attribute the Death of his Patient to the Poison of the Dart, than the want of Skill in himself.

14. As to their Morals, they are simple and credulous, rather honest than otherwise, and unpractised in the *European* Art of Lying and Dissimulation; but as to the brutal Passions, they are sottish and sensual as the Beasts of the Field.

15. They are almost always either eating or sleeping, unless when they go a hunting: At all Hours of the Night, whenever they awake, they go to the *Homing-pot*, that is, Maze dressed in a manner like

our pilled Wheat; or else a Piece of Venifon *barbecuted*, that is, wrapped up in Leaves, and roasted in the Embers.

16. They drink, I think, little besides *Succahanah*, that is, fair Water, unless when they can get Spirits, such as Rum, from the *English*, which they will always drink to Excess, if they can possibly get them; but do not much care for them, unless they can have enough to make them drunk; and I have heard it said, that they wonder much at the *English* for purchasing Wine at so dear a Rate, when Rum is much cheaper, and will make them sooner drunk.

17. They use *Tobacco* much, which they smoak in short Pipes of their own making, having excellent Clay, which I tried a little before I came for *England*, making Crucibles thereof, which I could not discern were inferior to the *German*. They make also neat Pots of the same Clay, which will endure the Fire for any common Uses.

18. They have no *Opium*, though in some old Fields upon *York River*, I found Poppies perhaps of no despicable Virtue. I have been told, that in Fevers, and when their Sick cannot sleep, they apply the Flowers of *Stramonium* to the Temples, which has an Effect like *Laudanum*. I have had asserted by many, that when the Soldiers were sent over to quell the Insurrection of *Bacon*, &c. they being at *James-town*, several of them went to gather a Sallad in the Fields, and lighting in great Quantities on an Herb called *James-town-weed*, they gathered it; and by eating thereof in plenty, were rendered apish and foolish, as if they had been drunk, or were become Idiots. Dr. *Lee* likewise assured me, that the same

Accident happened once in his own Family; but that after a Night or two's Sleep, they recovered.

19 Their *Sports* are Dancing, their *Games* are playing with Straws, which as I am not perfectly acquainted with, I find it hard to describe; I can therefore only tell you how it appears to a Looker-on: They take a certain Number of Straws, and spread them in their Hands, holding them as if they were Cards; then they close them, and spread them again, and turn them very suddenly, and seem very dextrous thereat. Their *Exercise* is Hunting, that is, Shooting with a Gun, or with Bow and Arrow, wherein they excel. Their Women work, plant the Corn, and weave Baskets or Mats.

20. Several have been very old; I cannot say, that herein there is any remarkable Difference between them and the *English* Natives. If the *English* live past 33, they generally live to a good Age; but many die between 30 and 33.

21. I have been told, that one of their famous *Wiobists* prophesied, that bearded Men (for the *American Indians* have no Beards) should come and take away their Country, and that there should none of the original *Indians* be left within a certain Number of Years, I think it was an Hundred and Fifty. This is very certain, that the *Indian* Inhabitants of *Virginia* are now very inconsiderable as to their Number; and seem insensibly to decay, though they live under the *English* Protection, and have no Violence offered them. They are undoubtedly no great Breeders.

22. Though they are sluggish by Nature, and slow of Speech, yet their Method of Expression seems

vehement and emphatical, and always attended with strong Gesticulations. They are generally well proportioned, and for the most part are rather taller than the *English*. They have all either a very dark-brown Hair, that may well be called black, or a Jet-black, all lank.

II. *An Experiment to prove, that Water, when agitated by Fire, is infinitely more elastic than Air in the same Circumstances; by the late Rev^d John Clayton, Dean of Kildare in Ireland. Communicated by the same Hand as the preceding.*

SIR *Thomas Proby* having heard of a new Digester, which I contrived, had a Desire to see it, and some Experiments made therein. I had a small one, which I designed only for an inward Cylinder; this I could easily put in my Pocket: Wherefore, going to pay him a Visit at *Elton* in *Huntingdonshire*, I took it along with me; and having softened a Bone therein in a very short Space, he was desirous to know the shortest Time it was possible to soften a Bone in: I told him, I thought I could soften the Marrow-bone of an Ox in a very few Minutes, but that that Vessel was very weak, and I feared would not endure the Pressure of so violent a Heat; yet seeming desirous to have the Experiment tried, I said I was ready to venture my Vessel: Then having fixed all things right, and included about a Pint of Water, and,

and, I believe, about 3ij of a Marrow-bone, we placed the Vessel horizontally betwixt the Bars of the iron Grate into the Fire about half way; and in three Minutes time I found it raised to a great Heat; whereupon I had a mind to have taken it out of the Fire, lest it should have burst; telling Sir *Thomas* of the Danger that I apprehended: For I remember'd, that the Screws of a Digester, made after Mr. *Papine's* Method, giving way, the Head flew one way and the Screws and Irons another, with such Violence, that the Head, having hit against a Brick, cut a Piece clearly out of it; which was one Reason and Motive to my contriving a Digester this way, that the Screws cannot possibly start, but that the Vessel would sooner break in any other Part: But in this (I added) I thought the Bottom would first burst, it being only foldered in. Scarce had I done speaking, and Sir *Thomas* thereupon moved his Chair to avoid Danger; but seeing the Heat become more raging, I stepp'd to the Side-table for the Iron wherewith I managed the Digester, in order to take it out of the Fire, when, on a sudden, it burst as if a Musquet had gone off. A Maid that was gone a milking, heard it at a considerable Distance; the Servants said it shook the House. As I had foretold, the Bottom of the Vessel, that was in the Fire, gave way; the Blast of the expanded Water blew all the Coals out of the Fire all over the Room; for the Back of the Fire-range was made just like an Oven, so that circulating therein, it brought forth all the Coals at the Mouth thereof. All the Vessel together flew in a direct Line cross the Room, and hitting the Leaf on a Table made

made of an inch Oak plank, broke it all in Pieces, and rebounded half way of the Room back again. What surpris'd me in this Event was, that the Noise it made at its bursting was by no means like the successive evaporating of an *Æolipile*, but like the firing off of Gunpowder. Nor could I perceive anywhere in the Room the least Sign of Water, though I looked carefully for it, and, as I said before, I had put a Pint into the Digester, save only that the Fire was quite extinguish'd, and every Coal belonging to it was black in an Instant.

But to confirm the Elasticity of Water, or to shew, at least, that there is a much stronger elastic Force in Water and Air, when jointly included in a Vessel, than when Air alone is inclos'd therein, I made the following Experiment: I took two $\frac{3}{4}$ vj Phials, into the one I put about $\frac{3}{4}$ v of Water, or better, and so corked it as well as I possibly could; the other I corked in the same Manner, without putting any thing into it. I inclos'd them both in my new Digester, Four-fifths being filled with Water; when the Heat was rais'd to about Five-seconds, I heard a considerable Explosion, and a jingling of Glass within the Vessel, and shortly after another Explosion, but not so loud as the former; whence I concluded, that both the Phials were broken. I then let the Digester cool leisurely, and the next Day I opened it; both the Corks were swimming on the Top of the Water, but only one of the Phials was broken, *viz.* that one into which I had not put any Water. At first, indeed, I concluded, that the Pressure or Dilatation of the Air in the empty Phial being stronger than the ambient

bient Pressure, forced forth the Cork, whereupon the Water, rushing in with Violence, might break the Phial; and therefore that this was the Cause also of the Loudness of the Explosion; whereas the other being mostly filled with Water, there being but a small Quantity of Air therein, just enough to force out the Cork, the Phial was not broken, but was preserved by the Force of the Water inclosed therein. But I have had Reason since to change my Opinion; for having had very strong Phials made, on Purpose to make some peculiar Experiments therewith, I took one of them, and having filled it about a quarter full with Water, and corked it very well, I set it in a square iron Frame, with a Screw to screw down the Cork, and keep it from flying forth. I then put it into a Digester, Four fifths filled with Water; which being heated to a due Height, when I opened it, I found the Cork forced into the Phial, though the Cork was so very large, that it amazed several who saw it, to conceive how it was possible for so large a Cork to be forced into the Bottle. Hence it manifestly appears, that the Pressure in the Digester, wherein was proportionately more Water, and less Air, was stronger than the Pressure within the Phial, wherein was proportionately more Air, and less Water. Then I reason'd thus also of the two former Phials: That the Air in the Phial, wherein was no Water included, making not a proportionate Resistance to the ambient Pressure in the Digester, wherein was a considerable Quantity of Water, the Cork was forced inward with such Violence, that it, together with the Water, dashed the Phial in pieces; but that in the other Phial, wherein there were Five-sixths of Water, the
inward

inward Pressure in the Phial being greater than the ambient Pressure in the Digester, wherein were but Four-fifths of Water, the Cork was thereby forced outward ; and that the small Difference between the proportionate Quantity of Water and Air in the Phial and in the Digester, being only as Four-fifths to Five-sixths, was the Reason not only why the Bottle was not broken, but also of the Faintness of the Explosion.

III. *Part of a Letter from John Green, M. D. Secretary of the Gentlemens Society at Spalding in Lincolnshire, to C. Mortimer, M. D. Sec. R. S. serving to inclose a Relation of a Girl three Years old, who remained a Quarter of an Hour under Water without drowning.*

S I R,

Spalding, Feb. 18. 1737-8.

THE inclos'd is what I receiv'd this Day from a Gentleman who lives on the Spot, and what you in yours so much desir'd. The Reason of the Child's being able to abide so long under Water is pretty evident: The Child, most likely, was infirm, weak, and sickly, from the Time of her Birth, so that the *Foramen Ovale* was not grown up. I remember about three Years ago to have seen a Subject, an old Woman 80 Years old, who had the *Foramen Ovale* so large, that you might easily thrust your middle Finger through it; but she was attended with the
above-

above-mention'd Circumstance, that is, she never enjoy'd a Moment's Health in her Life.

May 16. 1737. *Rebecca Yates*, of *Billson* near *Market-Bosworth* in *Leicestershire*, had a Daughter about three Years of Age, that fell into the Mill-dam at the Head, near to the Mill-wheel; and, by the Force of the Stream, was drawn under the Water to the said Wheel, with her Legs forwards; one of her Legs went under the Mill-wheel, and by reason of the Nearness of the Wheel to the Floor of its Water-way, the Bulk of the Child's Leg stopped the said Wheel from moving at all. The sudden stopping of the Mill so much surpris'd the Miller, that he went immediately, and let down the Shuttle; but finding it would not go quite down, he came up again into the Mill, and looked both above and below, to see if he could not find out the Cause; then went and drew up the Shuttle, and let it down again; but as the Gate would not shut quite down, he could not as yet find out the Cause of his Mill standing still; for which Reason he went backwards and forwards betwixt the said Shuttle and Mill-room, as nigh as he can guess, Eight or Ten times, before he found out the Cause; but at last he drew the Shuttle quite up, by which means the Force of the Water drove the Child from under the Shuttle; then he put the Shuttle quite down, and thereby discover'd the Child with her Leg under the Wheel, and lying upon her Face. The first Word she spoke was, *Help me*, which she repeated three times; the Miller left her Arm for some other Person to hold her, whilst he endeavour'd to remove the Wheel, so as to get out her Leg; and then she said again, *For God sake help me out, if*

you can: She spoke very briskly, after she was put to Bed. But the Mill-wheel had tore away all the Shin, Muscles, Sinews, and Tendons, of her Leg, quite to the Bone, and stript them down to her Heel; besides, the Shuttle was drawn up and let down upon the Small of her Back several times. The Child lived from *Monday* till *Friday*, and then died of her Wounds and Bruises; otherwise, in all Appearance, she might have lived to have made a fine Woman. The whole Time of her being under Water (and that at the Depth of four Feet and an half) was near 15 Minutes.

Attested by

John Bailey, *Miller*.

Rebecca Yates, *the Mother*.

The Mark † *of Grace Cooper,*
the Miller's Maid.

IV. *The Case of Mr. . . . Cox, Surgeon at Peterborough, who fell into a Pestilential Fever, upon Tapping a Corpse lately dead of an Hydropsy, drawn up by himself, and read before the Peterborough Society, Sept. 1. 1736. communicated to the ROYAL SOCIETY by the Rev^d Mr. Tim. Neve, Sec. Soc. Petroburg.*

AN elderly Gentlewoman, labouring of a Dropsy about 12 Months, underwent the Operation of Tapping four several times, by which 35 Quarts of

of Liquor were discharged; and dying at last of the same Distemper, I was desired by her Friends to let out the Water that was then contain'd in the *Abdomen*, as well to preserve the Corpse the longer from Putrefaction, as to prevent an Annoyance to the Company at the time of her Funeral.—Yet notwithstanding this was done within a few Hours after Death, the included Humours were arriv'd to such a Pitch of Putrefaction, as to discolour the external Parts with a green and livid Hue.—The Liquor itself was green, and somewhat thicker than new Milk, in Smell more fetid and offensive than what I ever met with, and so sharp and acrimonious in its Nature, as deeply to corrode a silver Canula, through which it passed.—And what shew'd it to be highly malignant, may be judg'd of from the following Circumstances.

The Night after the Operation, I was somewhat restless and uneasy, and the next Day afflicted with small Tremors, and an unusual Lassitude; in about three Days after, several angry Pustles arose upon my Hands and Fingers, and I believe on every Place where the least Drop of Water fell; some of which coming to Matter, went off soon; those which did not, continued painful, and remained much longer.—The Thumb of my Right Hand, and middle Finger of my other, were affected more severely than any other Part, the Pain more exquisite, the Swelling more hard and large, and of a red dusky Complexion. This was about the 6th Day of my Illness, and altho' the strongest Suppuratives were made use of, yet they fail'd of the desir'd Success, the Pains being continual.—Being persuaded from the great Pulsation

and heavy Pains I underwent, that Matter must lodge either under or upon the *Periosteum*, an Incision was made to the Bone, by which only two or three Drops of Matter were discharged.—'Twas expected this small Discharge might in some measure mitigate my Pain, but it did not; the same Evening, that Pain I at first complain'd of was changed into universal Convulsions, and the Oppression upon my Vitals so great, as to threaten immediate Death.

The Intentions of Cure (which were strictly attended to, by my ingenious Friend Dr. *Charles Balguy*) were to fortify the Heart with Cordials, to enable it to resist and throw out the Malignity, and to bring the Sores to a plentiful Digestion.

The first was treated with the highest Alexipharmacs, the latter, as at first, with strong Suppuratives: This being about the eighth Day of my Illness, and the Convulsions continuing, with an unequal and low Pulse, and as there was little Appearance of Matter, Blisters were plentifully applied, as near to the Parts affected as possible, in order to make a Revulsion from the Heart, and throw off the morbid Matter by the Wounds. In about three Days this Point was gain'd, the Convulsions began to abate, and the Wounds digest; in four more, I found a Cessation of Symptoms, except a Faintness and Lowness of Spirits, which hung upon me for a great while after, which pestilential Fevers (as this was judged one in an high Degree) are known always to leave behind them.

I suppose I might receive this Infection as much by Inspiration as Contact; for some of my Assistants, who were in the Room only, and never touched one Drop of the Liquor, found themselves much disorder'd,

der'd, and afterwards broke out with red and livid Eruptions; which sufficiently shew'd, that not only the Liquor itself, but the *Effluvia* too, were in the highest Degree subtle and malignant.

V. *The Variation of the Magnetic Needle, as observed in Three Voyages from London to Maryland, by Walter Hoxton.*

N. B. The Longitude is reckon'd from the *Lizard*.

The First Voyage 1732.

Latitude. North.	Longitude. West.	Variation. West.	
°	'	°	'
39	53	27	16 12
37	49	27	45 14
35	19	39	20 13
32	40	50	27 8
34	40	56	6 30
35	4	65	4 28
36	50		4 42
			4 58
			4 47

{ In Sight of the Island *Corvo*
 Difference of Longitude from it
 35 Minutes West.

{ Distance from Cape Henry se-
 ven Leagues.

{ In the Bay of *Chesapeake*, three
 Miles below the Mouth of
Potomack River.

{ Off the Mouth of *Potomack* Ri-
 ver.

Return.

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Return.

Latitude North		Longitude West		Variation. West	
°	'	°	'	°	'
36	11	56	20	9	22
34	52	53		6	17
34	33	52		6	15
34	45	51		6	5
34	36	50		6	23
36		49	30	7	37
37	20	48		9	23
38	4	48	20	10	
39	27	47	40	10	23
40	8	45	40	10	38
40	30	45		13	4
42	32	42	20	11	43
42	40	42		12	39
43	27	40	20	13	24
43	32	39	50	13	42
49	48	9		16	30

The Second Voyage 1733.

Latitude North.		Longitude West		Sun's Alti- tude	Variation. West.	
°	'	°	'		°	'
48	12	3	18	31	18	
46	7	4	30	25	16	35
44	4	7		22	16	22
42	17	9		33	16	36
40		12		37	15	38
38	5	14	20	41	14	51

Latitude. North		Longitude West		Sun's Alti- tude.	Variation. West	
°	'	°	'		°	'
37	36	14	45	25	13	24
36	32	15	52	47	13	17
36	16	16	12	19	13	
34	2	21	51	35	11	34
34	4	23	18	27	9	51
35	6	30	33	21	10	28
35	12	31	38	20	9	48
34	23	31	22	32	10	23
33	34	32	25	20	8	18
30	19	31	26	23	7	12
29	17	31	11	24	6	45
32	24	37	55	25	6	39
32	50	38	35	25	10	36
32	11	40	23	30	11	
31	19	41	9	25	6	42
32	25	43		26	5	
34	5	47	20	25	8	49
33	45	49	24	31	10	45
35	1	54	10	30	8	33
34		54	4	41	5	54
33	41	54		22	5	12
33	51	55		23	6	35
34	59	60		36	7	2
36	32	59	30	23	7	49
37	1	61	10	53	6	45
37	5	66	22	44	5	25
36	53	66	40	30	4	45
36	36			30	5	

In the Sounding,
20 Leagues off
Cape Henry.

Return.

Latitude. North.		Longitude West.		Sun's Alti- tude.	Variation. West.	
o	'	o	'		o	'
28	55	39	28	27	5	23
29	8	40		26	7	12
31	10	44	46	30	8	6
31	7	46	45	22	4	46
30	42	49		38	4	40
30	29	49	48	22	4	
30	31	52	10	25.	4	49
30	18	53		25	4	45
30	23	55		25	4	22
30	58	57	30	22	4	52
37	9	68		38	4	50

VI. *Some Thoughts and Conjectures concern-
ing the Cause of Elasticity, by J. T. Defa-
guliers, LL. D. F. R. S.*

A Ttraction and Repulsion seem to be settled by the Great CREATOR as first Principles in Nature; that is, as the first of second Causes; so that we are not solicitous about their Causes, and think it enough to deduce other Things from them. If Elasticity was admitted as a first Cause, (as it is by some) it is thought we should admit of too many principal Causes in Nature, which is contrary to the Rules of good Philosophy. Philosophers therefore have endeavour'd to deduce Elasticity from Attraction, or from Repulsion, or from both. It is observ'd, that the same Particles that repel each other strongly,

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will

will attract other Particles very strongly; as appears by many Chemical Dissolutions, especially by the alternate Dissolution and Precipitation of Metals in acid *Menstruums*. The Reverend and Learned Dr. *Hales* has proved this many Ways, in his *Vegetable Statics* and *Hæmastatics*. The Elasticity of Air seems to consist wholly in the repulsive Power of its Particles, which do not touch one another while the Air is in its elastic State; and if those Particles be brought nearer and nearer together, the Effect of their repulsive Force will increase, the Air's Elasticity being always proportionable to its Density by Compression, which Property will be preserv'd, though compress'd Air be kept a Year or two; notwithstanding Mr. *Hauksbee* in his *Physico-mechanical Experiments* says, that Air will lose part of its Spring by being very much compress'd. But the Air with which he try'd it, must have been fill'd with moist Vapours; and it is well known, that the Steam of Liquors will lose its Elasticity, especially where its Heat decays. I have kept several Wind-Guns, strongly charg'd, for half a Year together, in which the Air had lost none of its Elasticity: Others have found the Air as strong after a Year; and I have been told by a Person of Credit, that a Wind Gun having been laid by and forgotten for seven Years, when it was found, discharg'd its Air as many times, and with as much Force, as it used to do. Now, though Air, compress'd by any external Force, does always increase in Elasticity, as it diminishes in Bulk; yet it may, by Fermentation, diminish its Bulk very much, without gaining any more Elasticity: For if another Fluid, whose Parts repel one another, but attract the Parts of Air, be
mix'd

mix'd with Air, the Repulsion of any two Particles of Air will be diminish'd, in proportion as a Particle of the other Fluid, insinuating itself between them, attracts them towards itself on either Side. The same thing will happen to the other Fluid, in respect of the Particles of Air, which mixing with its Particles, do in the same manner destroy their Repulsion. Thus, if we allow an Attraction strong enough between the Parts of two elastic Fluids, it is possible, that by Fermentation a Solid may be made out of two elastic Fluids, which would have still continued fluid without such a Mixture. We are taught by Chemistry, to mix Fluids together, which immediately coalesce into a Solid. When Brimstone Matches are burning, the *Effluvia* of the Sulphur repel each other to great Distances, as may be known by the sulphureous Smell upon such an Occasion. Now, though these Particles repel each other, they attract the Air very strongly, as appears by the following Experiment:

Take a tall Glass Receiver clos'd at Top, holding about four Quarts of Air, and having put its open End over a Bundle of Brimstone Matches on Fire, standing up in the Middle of a large Dish with Water in it, (to keep the Air from coming in at the Bottom of the said Receiver) you will observe, that not only as soon as the Matches are burnt out, but a good while before, the Air, instead of being expanded by the Flame of the Brimstone, will retire into less Compass, the Water beginning to rise from the Dish up into the Receiver, and continuing so to do till some time after the Matches are burnt out; so that there will be in the Receiver only three Quarts of Air, instead of four (more or less, in pro-

portion to the Quantity of Brimstone burnt): And this plainly happens by some of the *Effluvia*, or little Parts of the Sulphur, attracting some of the Particles of the Air, so as to make an unelastic Compound, that precipitates into the Water. If the Elasticity of the Air is quite lost when the Repulsion of its Particles is taken off, or sufficiently counteracted, it must follow, that its Elasticity depends upon Repulsion: And that this is often the Case, appears by a great Number of Dr. *Hales's* Experiments, of which I will mention but a few. The Doctor took a Cubic Inch of Mutton-Bone, and having put it into his Gun-Barrel Retort, he distill'd out of it two or three hundred Cubic Inches of Air into a large glass Bottle, the Weight of which Air, together with the Ashes of the Bone left, weighed as much as the whole Quantity of Bone did at first. Now the Air had been confin'd in that Bone, together with many sulphureous Particles, in such manner, that the mutual Attraction of the Sulphur and the Air had alternately destroy'd each other's repulsive Force, and brought those Substances into a little Compass; but the Fire in the Distillation separated them from each other, so as to restore them, in a great measure, to their usual Elasticity. This appear'd by bringing a Candle near the Mouth of the Bottle that held this reviv'd Air; for every time the Candle was brought near, the Air took Fire, and flash'd out of the Bottle with a sulphureous Smell. The Air may be consolidated in many hard Bodies, so as to be there quite void of Elasticity, and there do the Office of a Cement, till by the Action of Fire, or some particular Fermentations, it is again restor'd to its perfectly elastic State.

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This is the Meaning of the Doctor's Words, when he says, that some Bodies *absorb*, and others *generate* Air; and the same Bodies do sometimes absorb, and at other times generate Air. He found more or less Air in almost every solid Substance that he try'd; but, what was most remarkable, he found that the *Calculus humanus* (or Stone taken out of a Man's Bladder) was made up of above half its Weight of Air.

Some have endeavour'd to solve Elasticity by Attraction only; as for Example: If the String *AB* (TAB. I. Fig. 1.) be consider'd as made up of Particles lying over one another in the manner represented at *ALB*; it is plain, that if the Point *D* be forcibly brought to *C*, the Parts will be pull'd from each other; and when the Force, that stretch'd the String, ceases to act, the Attraction of Cohesion (which was hinder'd before) will take place, and bring back the String to its former Length and Situation after several Vibrations. Now, though this seems to agree pretty well with the *Phænomena* of a String in Motion, it will by no means solve the Elasticity of a Spring fasten'd at one End, and bent either way at the other, like a Knife or Sword-blade, as in Fig. 2. For if such a Spring be bent from *A* to *a*, the Particles on the Side *C*, which now becomes convex, will be farther asunder at *F*, while the Particles at *D*, carried to the concave Part *E*, will come closer together: So that the Attraction, instead of making the Spring restore itself, will keep it in the Situation in which it is, as it happens in Bodies that have no Elasticity, where perhaps only Attraction obtains. Thus a Plate of Lead, a Plate of Copper, and a Plate of soft Iron, stands bent.

But

But the most probable way of solving the Elasticity of Springs, is to consider both a repulsive and an attractive Property in the Particles, after the manner of the black Sand, which is attracted by the Loadstone, and has been shewn by the learned and ingenious Professor *Petrus van Muschenbrook*, to be nothing else but a great Number of little Loadstones.

Fig. 3. Let us suppose a Row of round Particles touching one another only in the Points *c* in a Line from *A* to *B*. It is plain, from what Philosophers have shewn, concerning the Attraction of Cohesion, that upon the least Shake, or Alteration of the Position of a strait Line, these Particles will run together, and form a Sphere, in which the Globules will have more Points of Contact. But if these Particles have Poles like Magnets in the opposite Places mark'd *n, s*, so that all the Poles *n, n, n*, &c. repel one another; and all the Poles *s, s, s*, &c. do likewise repel one another, the Line *AB* will continue strait; for if by any Force the said Line *BA* be put into another Position, as into the Curve *ba*, then the Poles *nn*, &c. being brought nearer together, (while the Poles *ss*, &c. are farther asunder) will repel one another more strongly, and thereby hinder the Globules from running together towards the concave Part; and the Spring, left to itself, (all this while supposing one End, as *b, B*, or β , fix'd) will restore itself, throwing its End *a* back to *A*, and so on to α , by the first Law: Then being in the Position $\alpha \beta$, the Poles *s, s*, &c. are brought nearer together, whose Repulsion, thus increas'd, throws back α to *A*, and so on forward, the Line of Particles performing several Vibrations round *B*.

May not a Spring of Steel, or other Springs, consist of several Series of such Particles, whose Polarity and Attraction acting at the same time, will shew why such Bodies, when they have been bent, vibrate, and restore themselves?

If we take a Plate of Steel, and make it so hot till it looks white, and then immediately quench it, we thereby fix the Metal in a State very near Fluidity, so that the Particles which the Fire had almost brought to Roundness, have but a very small Contact; as appears by the Fragility of the Steel thus harden'd, which breaks like Glass, and has a short Grain. Steel, thus harden'd, is highly elastic; for what Workmen call *hard*, is the most *elastic*: as appears by the Congress of high-harden'd Steel Balls, which return, in their Rebound, the nearest to the Place we let them fall from; and, next to Glass, have the quickest Elasticity of any thing we know.

That we may not be thought to have given an imperfect Account of the Elasticity of a Steel Spring, because such an one as we have describ'd wants Toughness, and will immediately fly when bent to any Degree; we must beg Leave to consider farther the Properties of the round Particles, or little Spheres, of Steel, in which we have suppos'd a Polarity.

Let us suppose *AB* (Fig. 4.) to be two little Spheres or component Particles of Steel, in which, at first, we will suppose no Polarity, but only an Attraction or Cohesion. Then, whether the Particles have their Contact at *c, d, e, n*, or at *δ, ε, s*, their Cohesion will be the same; and the least Force imaginable will change their Contact from one of those Points to another; because in the rolling of these little Spheres,
they

they do not come into more or less Contact in one Situation than another. But if we suppose the Point n in each Spherule to be a Pole with a Force to repel all the other Points n in any other Spherule, and likewise s another Pole, repelling the other Points s ; the Spherules will cohere best, and be at Rest in that Position where the Points c, c , are in Contact, and n and s at equal Distances on either Side. For if the Spherules be turn'd a little, so as to bring the Points d, d , into Contact, as in Fig. 5. the Poles n, n , being brought nearer, act against each other with more Force than the Points s, s , which are now farther off, and consequently drive back the Spherules to the Contact at c, c , beyond which continuing their Motion, they will go to d, d , Fig. 6. and so backwards and forwards, till at last they rest at c, c , which we may call *the Point of Equilibrium for Rest* in a Spring. Now there are, besides this, two other *Points of Equilibrium*, beyond which the Spring may break, which are the Points e, e towards n , and ϵ, ϵ towards s ; see Fig. 7. that is, when the Spherules have their Poles n, n brought very near together, the mutual Repulsion increases so, that the Attraction at the Contact is not able to hold them, and then they must fly asunder, the Spring breaking. We suppose the Points e, e , to be the Points of Contact, beyond which this must happen; but that if the Contact be ever so little short of it, as between e and d , the Spherules will return to their Contact at c , after some Vibrations beyond it, as has been already said. This is the Reason why I call e , (in one of the Spherules) and its correspondent Point ϵ on the other Side ϵ , *the Points of Equilibrium*; for if the Spring be bent

bent towards *a* (Fig. 3.) so that the Spherules, like *A* and *B*, (Fig. 7.) touch beyond *e*, the Spring will break: Likewise if the Spring be bent the other way, till the Spherules touch beyond *e*, then it will break the other way. Now when the Spherules touch at *e, e*, or at *e, e*, the Spring is as likely to return to its first Position as to break; for which Reason I have call'd the Points *e* and *e*, *Points of Equilibrium*, as also having known by Experience, that a Spring left bent to a certain Degree, has, after some time, broke of itself.

From all this it appears, that Spherical Particles will never make a tough Spring; therefore the Figure of the Particles must be alter'd, in order to render it useful; and this is what is done in bringing down the Temper of the hard Steel, and *letting down a Spring*, as it is call'd. What Change ought to be made in the Particles, we shall first shew; and then consider how far that is done by those who make Springs.

If the Parts suppos'd Globules, as in Fig. 3. are now flatten'd at *c*, where the Contact is, so as to put on the Shape *n e d c d e s*, (as in Fig. 8.) the Contact will be much increas'd, and reach from *d* to *d*, so that in bending the Spring there will still remain a great Contact in the Particles, and the Points of *Equilibrium* for breaking (*viz.* *e, e* above, and *e, e* below) will be remov'd nearer to the Poles *n*, or *s*, than when the Particles are round; the Consequence of which will be, that the Spring must be bent much farther, to be in Danger of breaking, than in the former Supposition; as may be seen in Fig. 9. where two Particles being open'd about the Point *d* as a

A a

Centre,

Centre, the attracting Points c, c , and d, d , have still some Force to help to bring back the Particles to their whole Contact; because in this Shape of the Particle the attracting Points c, c , d, d are remov'd but in Proportion to their Distance from the angular Point d ; whereas if the Particles had been spherical, and the Line dd an Arc of a Circle, the attracting Points c, c , and d, d , would have remov'd from one another farther than in Proportion to twice the Square of the Distance from d , (as in Fig. 5.) and so have afforded very little Help for bringing back the Particles to their Contact. A Row of Particles in the Spring thus condition'd, is to be seen in the natural State at BA , Fig. 10. and bent at ba in the same Figure. Here it is to be observ'd, that if in this Figure of the Particles you would bend the Spring to bring the Particles to touch at their Point of *breaking Equilibrium*, you must open them so much on the contrary Side, that the Spring will be bent far beyond any Uses intended to be made of it, as appears by Fig. 11. where two Particles are brought to touch at the equilibrating Point e ; and by Fig. 12. where many Particles being put into that Condition, the Spring is brought round quite into a Circle.

Now the common Practice in making Springs is the most likely to produce this Effect requir'd in the Particles; for the hard Spring, whose Particles were round, or nearly so, is heated anew, and whilst it is cooling gently, the mutual Attraction increases the Contact, so that the Particles grow flatter in those Places where before they had but a small Contact; and lest this Contact should become too great, the Spring's Softening is stopp'd by quenching it in Water,

or

or Oil, or Grease. Another way of making Springs, is to begin and shape them in cold unelastic Steel, and then having heated them to a small Degree, for Example, to a Blood red Heat, immediately to cool them in some proper Liquors. This also settles the Particles in their oblong Figure, through which they must pass before they become round, or nearly so, in a white Heat. That Particles of Steel are fix'd in the Figures which they have at the Instant of dipping, will not appear strange, when we consider, that dipping red-hot Steel in cold Liquors, in a particular Position, makes it magnetical. If it be ask'd, How we account for making Springs only with hammering, it is easily answer'd, That we can make Iron and Steel magnetical only with hammering; and if we can give and destroy Poles in the whole Piece, there is no Improbability to think we can give Poles to little Parts; or rather bring into a particular Situation the Poles which they have; for if the Poles that we have consider'd be plac'd quite irregularly, there will be no Elasticity at all. Agreeable to this, Springs may be made of other Metals than Iron or Steel, though not so perfect, by Hammering; for it will be sufficient for the little Particles to have Poles that attract and repel one another, driven by the Hammering into a regular Order.

N. B. *This, apply'd to the Vibration of a String, will better solve its several Cases than Attraction alone*; and the Elasticity of Glass is just the same as that of a very brittle *Steel-Spring*.

VII. *Some Thoughts and Experiments concerning Electricity*, by J. T. Desaguliers, LL. D.
F. R. S.

THE *Phænomena* of Electricity are so odd, that though we have a great many Experiments upon that Subject; we have not yet been able from their Comparison to settle such a Theory as to lead us to the Cause of that Property of Bodies, or even to judge of all its Effects, or find out what useful Influence Electricity has in Nature: Though certainly, from what we have seen of it, we may conjecture, that it must be of great Use, because it is so extensive.

Though some Persons have been too hasty in their Conjectures, and too apt to run into Hypotheses not sufficiently supported by Experiments; yet it would be of great Use to settle some general Propositions concerning Electricity from the Light we have already, and what we may further discover by future Experiments; provided we have a sufficient Number of them to settle a general Rule. For Example; I now propose some general Assertions to be consider'd, and to be reject'd or allowed of as a Number of Experiments shall determine; but to stand only as *Queries* till they are settled.

I have hitherto avoided entertaining the SOCIETY upon this Subject, or pursuing it so far as I might have done, (considering that I can excite as strong an Electricity in Glass, by rubbing it with my Hand, as any body can) because I was unwilling to interfere
with

with the late Mr. *Stephen Gray*, who had wholly turn'd his Thoughts that way; but was of a Temper to give it intirely over, if he imagin'd, that any thing was done in Opposition to him. But now I intend not only to go on myself in making electrical Experiments, but shall always be ready to make such as shall be propos'd by any Member of the SOCIETY. The *Queries* which I have already examin'd, are the following:

Query I. Whether all Bodies in general are not capable of receiving the Electricity which has been given to a Tube by Friction, though there be a great many Bodies, such as Metals and Vegetables, &c. in which we have not hitherto been able to excite any Electricity by Heat, or Friction, or any other Operation on the Bodies themselves?

Query II. Whether when a String is stretch'd out at Length, with a Body hanging at one End of it, to which Body we would communicate the Electricity of the Tube rubb'd at the other End, the Supporters of the String ought not to be of such Bodies as are capable of having Electricity excited in them by Friction, Heating, Beating, or Patting, or some immediate Operation on the Bodies themselves?

Query III. Whether these Supporters of the String (mention'd in the last *Query*) which stops the electrical Virtue from passing any farther, are not of such a kind as are incapable of having the electrical Virtue excited in them immediately by any Operation yet known; though they are all capable of receiving it from a rubb'd Tube, even at a great Distance, by the Communication of a String made of vegetable Substances?

Query

Query IV. Whether the Reason that some Supporters transmit the Electricity running from the rubb'd Tube along the String to Bodies beyond them, be not as follows, *viz.* That having receiv'd some of the electrical Stream; they soon become saturated with it, and so receiving no more of it, let the rest pass on without disturbing it?

Query V. Whether the Reason, that Supporters made of vegetable Substances, Metals, and such others, as stop the Electricity above-mention'd from running any farther along the String than the Place where it rests upon them, be not this? *viz.* That they are never saturated with the electrical Stream, but continually receive it, and transmit it to the next contiguous Body, provided that contiguous Body be of the same kind with themselves, and also contiguous to other Bodies of the same sort: I mean such as would stop the Electricity, if the String was supported by them. For even these Supporters will transmit the Electricity, if terminated at each End by Bodies that transmit the Electricity, when they support the String.

Query VI. Whether we may not distinguish all Bodies in general, in respect of Electricity, into such as may be excited to Electricity, and such as cannot be excited to Electricity? the two kind of Bodies receiving the Electricity from other Bodies into which it has been excited differently; the first also transmitting the Electricity, while the others do not.

These *Queries* are such as arise from a Consideration of Experiments made by others, and such as I have made myself.

'As I go on in making other Experiments, other *Queries* may arise, and I shall communicate them.

Here follow the Experiments I have already made, and am ready to repeat as the SOCIETY may desire.

EXPERIMENTS *relating to the First Query.*

I stretch'd a Cat-gut about five Feet in Length, and fasten'd it to the Top of two Chairs in an horizontal Situation, and such another Cat-gut String to two other Chairs parallel to the first, and at the Distance of 15 or 20 Feet from the former. Then I suspended one End of a Packthread to the Middle of the first Cat-gut, and carried it on so as to lay it over the Middle of the other Cat-gut, and leave the other End of the Packthread hanging down about a Foot below the Cat-gut, with a Loop to hang several Bodies to it, successively to receive the Electricity excited by the Tube, and applied to the other End of the Packthread.

All the Bodies I tried received the Electricity communicated from the rubb'd Tube along the String, which appear'd by holding a Thread fasten'd to a Stick, the Thread being attracted towards the suspended Body.

1. A Gold Medal. 2. A Silver Medal. 3. A Copper Medal. 4. A Brass Ball. 5. A Steel Ball. 6. A Tin Ball. 7. A Leaden Ball. 8. Sulphur. 9. Sealing-Wax. 10. Pumice-Stone. 11. Bees-Wax. 12. Resin. 13. *Sal Armoniac*. 14. Ivory. 15. Human Bone. 16. Fish-Skin. 17. Loadstone. 18. Flesh. 19. Cotton. 20. Wax-Candle. 21. Tallow-Candle. 22. A Leak. 23. Celeri. 24. Tobacco-

bacco-Pipe. 25. A Glass-Ball. 26. A Rush rolled up.

EXPERIMENTS *relating to Query II.*

Retaining the first supporting String of Cat-gut, instead of the last Cat-gut Supporter, I made the Packthread pass over the following Substances successively, all which transmitted the Electricity to the Body suspended at the End of the Packthread; *viz.*
 1. A Silk String. 2. Hair Rope. 3. Parchment.
 4. A Thong of Sheep-skin, but it stopp'd the Electricity till it was dry and warm. 5. A Lift of Woollen Cloth. 6. A Lift of Flanel. 7. Cadis, or a kind of Worsted Tape. 8. Quills. 9. Whalebone. 10. A Man's Thigh-Bone. 11. A Bladder. 12. A Cat, held between two. 13. A Tallow-Candle. 14. A Wax-Candle (the String was also laid over the unburn'd Cotton Wick at the End of the Candle). 15. A Tallow-Candle and its Wick. 16. Tobacco-Pipe, with a Cat-gut or a Packthread through it, or without, that is, a Packthread String being fasten'd at each End of it. 17. A Sword-Belt. 18. A Piece of a white Hat. 19. A Piece of a black Hat. 20. A Glass Tube. 21. The same with Water in it. 22. With Spirit of Wine. 23. The same with Mercury in it. 24. Sealing-Wax. 25. Crape.

N. B. All these Substances, except the Sheep-skin, the Tobacco-Pipe, the Quills, the Candles, and the Bone, not only transmitted the Electricity, but became so far electrical, as to attract the Thread a little way on each Side of the supported Packthread.

There are more Experiments requir'd to be made, before this *Query* can be turn'd into an Assertion.

EXPERIMENTS *relating to Query III.*

Instead of the last Supporter of Cat-gut near the suspended Body, I made use of the following Substances stretch'd from Chair to Chair; and then the Thread hanging on the Stick was not at all attracted by the suspended Ivory Ball, which I made use of in all the Experiments to try the Supporters.

1. A Hempen Rope. 2. A small Packthread. 3. A drawn Sword. 4. A Sword in the Scabbard. 5. The Scabbard without the Sword. 6. A twisted Cotton Thread. 7. Tape made of Thread. 8. Bars, Tubes and Wires of Copper, Brass, Iron and Lead. 9. White Paper and brown. 10. A moist Thong of Sheep-Skin. 11. Celeri. 12. Leeks. 13. Fir-wood. 14. A Cane. 15. A Piece of black Thorn. 16. The same Rushes that had before receiv'd the Electricity when suspended. 17. A Sponge dry. 18. White Thread. 19. Hay. 20. A Marble Slab.

N. B. Such Bodies as were too short to reach from Chair to Chair, were lengthen'd out by Pieces of Packthread at each End.

EXPERIMENTS *relating to Query IV.*

The Cat-gut Supporters, and all the others mention'd in the Experiments to *Query III.* which transmitted the Electricity, attracted the Thread of the Stick near the conducting Packthread, but not so far as the Chairs to which the said Supporters were fasten'd.

EXPERIMENTS *relating to Query V.*

All the Supporters which did not transmit the Electricity, when they reach'd from Chair to Chair, were made to transmit, when they were lengthen'd out with Cat-gut at each End, and then they became electrical themselves from one End to the other, as becoming part of the suspended Body; and becoming so saturated, as not to be able to carry the Electricity on either Side any farther than the Cat-gut to which they were fasten'd.

EXPERIMENTS *relating to Query VI.*

The late Mr. *Stephen Gray* has, by rubbing, excited Electricity in several of those Bodies which I have made Supporters of to transmit the Electricity (See *Philosoph. Transf.* N^o 366.): I have done the same with several others, but not with all of them, though I shall try them all: But as it is more difficult to excite that Virtue in some than others; and all the Experiments in general succeed better in dry and cold Weather than in moist and warm, I must wait for proper Opportunities to make the Experiments, and then I shall communicate them.

EXPERIMENTS *concerning mix'd Substances.*

1. Cadis (or Woollen Tape) laid on Thread-Tape, when made a Supporter, transmitted the Electricity.
2. When the Thread-Tape was uppermost, the Electricity was stopp'd.
3. When they were twisted together, the Electricity was transmitted, but most weakly when the Pack-thread

thread going to the Ball was laid over that Part of the Twist which had the Thread-Tape.

N. B. The two Paper Supporters which did not transmit the Electricity, ought to have done it according to *Query* II. because, by Mr. Gray's Experiments, Electricity is to be excited in the Paper by rubbing: Therefore, perhaps, the Papers wanted to be drier or warmer, so that I shall try them again. These are the only two Experiments that do not agree with the second *Query*; but I would not omit mentioning them, because it is the Part of an impartial Philosopher to mention as well those things which favour, as those that disagree with his Hypotheses and Conjectures.

VIII. EXPERIMENTS ·made before the ROYAL SOCIETY, Feb. 2. 1737-8. by J. T. Desaguliers, LL.D. F. R. S.

N. B. **I**N the following Account, which is the Sequel of former Experiments, I call *Conductors* those Strings, to one End of which the rubb'd Tube is applied; and *Supporters* such horizontal Bodies as the *Conductor* rests upon.

EXPERIMENT I.

Old Packthread Supporters transmitted Electricity but weakly, though more strongly when twisted with Cat-gut; but new Packthread did better.

N. B. *Where it is not mention'd otherwise, an Ivory Ball hangs at the End of the Conductor;*

and its Electricity is tried by a Thread applied near it.

EXPERIMENT II.

A Conducting String of Cat-gut receiv'd the Electricity a little way; but did not carry it quite to the Tube.

EXPERIMENT III.

Two conducting Strings, one of Cat-gut, and one of Packthread, compar'd, the first attracted less and less, as the Distance from the Tube increas'd; and the other more and more, till it was strongest at the suspended Body: But both ceas'd immediately after the Removal of the Tube.

EXPERIMENT IV.

A Sealing-Wax Supporter transmitted the Electricity, but did receive little or none when suspended. If it was but just rubb'd with the Hand, it attracted the Thread when first suspended; and strongly, if much rubb'd; but that Virtue was soon lost, if the Tube was apply'd to the conducting String, and then it would receive no more Electricity from the Tube. If the Stick of Wax was wet, then it would strongly receive the Electricity.

A Wax Supporter wet, and Silk String wet, did not transmit the Electricity.

EXPERIMENT V.

Dried Ox-Guts did not transmit Electricity when held in Hand; but when tied to Cat-gut, transmitted it; and, when suspended, received it plentifully.

E x-

EXPERIMENT VI.

The same with a small Cord.

EXPERIMENT VII.

The same with a Rod of Iron, and Tube of Brass.

EXPERIMENT VIII.

A Glass Tube, made Conductor, receiv'd the Electricity but a little way.

EXPERIMENT IX.

Dry Sheep-Skin transmitted the Electricity, but not when wet, though it receiv'd it then when suspended.

EXPERIMENT X.

A middle Supporter of Packthread was again supported on one Side by a Glass Tube, and on the other by Sealing-Wax, and had at each End an Ivory Ball hanging. Those Balls became electrical in the same manner, and at the same time, as the Ball at the End of the conducting Spring.

EXPERIMENT XI.

When a Bar of Oak was made use of instead of the Tube, or a small Iron Bar instead of the Wax, the Electricity was stopp'd: But if the Bar was thrust a little way into a Glass Tube, the Electricity was communicated as before.

EXPERIMENTS *made at the* ROYAL SOCIETY; Feb. 9. 1737-8.

I fixed six Iron *Radii* of twisted Iron Wire to a Brass Ring of two Foot and an half Diameter, and half an Inch wide, which had a Socket in the Centre, whereby to set it either on an upright Glass Tube, or on a wooden Pillar: Then I hung upon the End of the six *Radii*, next to the Circumference, the following Substances. 1. A Piece of Resin. 2. A Stick of Wax. 3. An Apple. 4. An Ivory Ball. 5. A Steel Ball. 6. A Glass Ball.

EXPERIMENTS I. and II.

I rubb'd the Tube, and applied it to the Centre of this Machine, as it stood on a Glass Tube; and the Electricity was communicated to all the suspended Bodies, and the Ring also; but none of them receiv'd it, when the Machine stood upon a wooden Pillar, whose Foot was on the Floor.

EXPERIMENT III.

I tied to the Ends of the six *Radii* as many Cat-gut Strings, but so long as to unite together about a Foot higher than the Centre of the Ring, where I suspended them by another Cat-gut String three Foot long, the Top of which was fasten'd to an hempen Rope. Then applying the rubb'd Tube very near the Place where all the Cat-gut Strings join'd over the Ring, (at which Ring the same Bodies were suspended

as before) neither the Bodies nor Ring receiv'd any Electricity.

N. B. This was done in foul Weather, when the Electricity does not extend itself far from the Tube: But in fair Weather, the Electrical Virtue, at the same Distance, reach'd the Iron *Radii* of the Ring; and consequently the Ring and Bodies suspended, though the Virtue was not propagated along the Cat-gut: For if the Tube was applied a little higher to the single Cat-gut, so as the *Effluvia*, or Virtue darted directly from the Tube, did not reach the Ring, or its Iron *Radii*, then no Virtue was communicated to the Ring, or the suspended Bodies, &c.

EXPERIMENT IV.

I suspended the Ring by six Packthreads, just in the same manner as the Cat-gut Strings before; but still all those Strings were suspended by the perpendicular Cat-gut of three Foot in Length. Then all the Bodies receiv'd the Electricity from the rubb'd Tube applied to the Top of the Pyramid of Packthreads.

EXPERIMENT V.

Instead of the perpendicular Cat-gut between the Pyramid of Packthread and the upper hempen String, I substituted a Packthread; and then no Virtue was communicated to the Ring, but all went up the hempen String, and was lost; except the Tube was held very near the Ring, and then it gaye a small Degree of electrical Attraction to the Ring, and the Bodies suspended at it.

EXPERIMENT VI.

Having again suspended the Ring with the Bodies and Pyramid of Packthreads to the perpendicular Cat-gut, I tied a Packthread to the Ring, and carried it horizontally about 20 Feet from the Ring; and having fasten'd a Cat-gut String three Foot long to it, I gave it an Assistant to hold: Then applying the rubb'd Tube to the End joining that Cat-gut, the Electricity was communicated to the Ring, and all the suspended Bodies, as appear'd by applying the white Thread near them, which was attracted by every Part of the Ring, and all the Bodies.

EXPERIMENTS *made before the* ROYAL
SOCIETY, Feb. 16. 1737-8.

EXPERIMENT I.

I applied the rubb'd Tube to a burning Candle, and it had no manner of Effect on the Flame; but as soon as the Candle was blown out, it attracted the Smoke at four or five Inches Distance.

EXPERIMENT II.

An horizontal Packthread, of about 18 Feet in Length, being terminated by the Cat-gut Strings, of three Foot long each, I hung (towards one of the Ends of the Packthread) upon it a Candlestick with a lighted Candle in it; then applying the rubb'd Tube to the other End of the Packthread, the Candlestick attracted the Thread, and it was also attracted by the
Candle,

Candle, but not within two or three Inches of the Flame; but as soon as the Candle was blown out, the Thread was attracted by every Part of it; nay, even the Wick, when it was quite extinguish'd.

EXPERIMENT III.

I suspended a Wax Candle in the same manner, and the Experiment succeeded in the same manner; only the Electricity came not so near the Flame in the Wax as in the Tallow Candle.

EXPERIMENT IV.

I hung an Iron Wire 16 Foot long horizontally by two Cat-gut Strings at its Ends about three Foot long each, and bent down the Wire from the Place join'd to the Cat-gut, so as to hang down a Foot at one End; then applying the rubb'd Tube at the other End, this Conductor carried the Electricity along to the Ball; but not so well as the Packthread Conductor; but it did something better when it was wet.

The same happen'd when the Conductor was Brass Wire of the same Length.

N. B. The Packthread Conductor also carried the *Effluvia* stronger when it was wet.

IX. *An Account of some Electrical Experiments
made before the ROYAL SOCIETY on
Thursday the 16th of February 1737-8.
By the Same.*

EXPERIMENT I.

TAB. I. Fig. I.

I Took the Glas Tube *AB* of two Inches Diameter, which had at one End *A*, a Brass Ferril with a Brim cemented to it, and at the other End *B*, a Brass Cap close at Top, the Brass-work being join'd to it, in order to exhaust it of its Air upon Occasion. When this Tube was very dry, it would become electrical by rubbing, so as to snap by passing the Ends of the Fingers near it; but that Virtue could not be excited in the Tube nearer the Brass at the Ends than from *a* to *b*, and not unless the Tube was very dry within.

The Tube being thus prepar'd, and having an Ivory Ball *C*, of about two Inches Diameter, tied to it at the End *B* by a short String, I passed the Tube through the horizontally suspended Plate *DD*, till it was stopp'd by the Brim at *A*; and as it hung perpendicularly, the Ball *C* was within a Foot and an half of the Floor. The Plate *DD* was about 10 Inches in Diameter, and suspended by three small Cat-gut Strings as *E, e*, of about two Feet in Length, all which were tied together at *E*, to an hempen String hanging from the Ceiling at *F*.

By

By reason of the Distance of the Ends of the Cat-gut Strings close to the Plate at *eee*, I was able to thrust in between them one End of an open Tube *GG*, after I had rubb'd it so as to make it electrical, to see whether I could make the aforesaid suspended Tube *AB* the Conductor of Electricity to the Ball *C*; but the first Trial was in vain.

EXPERIMENT II.

Then laying horizontally over the Plate *DD* an Iron Bar a quarter of an Inch thick, and a Yard long, I hung at the Ends of it two Ivory Balls *cc*, of the same Size as *C*, by Packthreads of the same Length as the Tube *AB*.

Having again made the Tube *GG* electrical, I applied it over *A*, as before, and immediately the two Balls *cc* received the Electricity, so as to attract the *Thread of Trial T* hanging at the End of the Stick *ST*, when applied near them; though it received no Motion when applied to *C*. But if the Strings *Hc*, instead of Packthread, were Cat-gut, then the Balls *cc* received no Electricity from the Tube *GG* rubb'd and applied over *A*.

N.B. To be sure that the rubb'd Tube is made electrical, I pass my Fingers near it after rubbing, to hear whether it snaps; but always rub again before I apply it; because by snapping it loses its Electricity at the Place where it snaps.

EXPERIMENT III.

When I rubb'd the Tube *AB*, it would then attract the Thread of Trial *T* between *a* and *b*; but not at

all above *a* or below *b*, unless when I applied the Tube *GG* above *A*: Then the Thread of Trial would be attracted by the Plate *DD*, and the Top of the great Tube from *A* to *a*, but no lower. It would also be attracted by all the Bar *HH*, and only three or four Inches below *H*.

EXPERIMENT IV.

Having fill'd the Tube *AB* with Water, the Electricity of the rubb'd Tube *GG*, applied at *A*, ran strongly down the Tube *AB*, and impregnated the Ball *C*, so as to make it strongly attract the Thread of Trial, whilst the Balls *cc* received no Virtue at all. But upon wetting the Cat-gut Strings *Hc* with a Sponge, all the three Balls *cC* and *c* strongly receiv'd the electrical Virtue.

EXPERIMENT V.

I took away the Bar *HH*, and its Balls and Strings; and having well dried the Tube, I rubb'd it, and hung it up as before; so that it would snap, or attract the Thread from *a* to *b*, but no-where else.

Then putting the small Bar *HH* into the Middle of the Tube *AB* in its Axis represented by the prick'd Line, upon Application of the rubb'd Tube *GG* at *A*, the Virtue was immediately communicated to the Ball *C*. The same thing happen'd, when, instead of the Bar, a Brass Wire, a Walking-Cane, a small green Stick, or small Packthread, was placed in the Axis of the Tube.

EXPERIMENT VI.

I took a Barometer Tube empty, and very dry, and placed it in the Axis of the great Tube *AB*; but it would conduct no Electricity to the Ball *C*; though it carried it down very readily when full of Water; though quite dry on the Outside.

Another small Tube open at both Ends, which conducted no Virtue to *C* when dry, being only moisten'd a little by the Breath in blowing through it, carried down the Virtue from *A* to *C* very strongly.

N. B. All this while the Cat-gut Strings *Ee* received no electrical Virtue.

As I design to pursue these Inquiries much further, I beg Leave to be allow'd to make use of some Terms, (which I shall here define) in order to save using many Words in giving an Account of some electrical Experiments, which I have made, and shall hereafter make.

DEFINITION I.

A Body *electrical per se* is such a Body in which one may excite Electricity by Rubbing, Patting, Hammering, Melting, Warming, or any other Action on the Body itself, as Amber, Sealing-Wax, Glass, Resin, Sulphur, &c. besides many, if not all, Animal Substances.

DEFINITION II.

A *Non-electrical* is such a Body as cannot be made electrical by any Action upon the Body itself
im-

immediately ; though it is capable of receiving that Virtue from an *Electrical per se*.

O B S E R V A T I O N S.

1. When the Air is full of moist Vapours, *Electricals per se* are excited to Electricity with very great Difficulty, requiring to be often warm'd, and much rubb'd ; as appears in exciting that Virtue in Glass, Amber, Wax, &c.

2. In dry Weather, especially in frosty Weather, the *Electricals per se* will have their Virtue excited with very little Action upon them ; as appears by warming a Glass Receiver, which, without any rubbing, will cause the Threads of a Down Feather, tied to an upright Skewer, to extend themselves as soon as it is put over the Feather. Sometimes Resin and Wax exert their Electricity by only being expos'd to the open Air.

3. *Electricals per se* retain the Virtue longest when kept near to, or inclos'd by, other *Electricals per se*. Thus the rubb'd Tube will retain its Virtue pretty long in dry Air, as appears by chasing a Feather about the Room very long without new rubbing ; as also by Lumps of Resin and Sulphur, &c. which have been melted and poured into dry Drinking-glasses, keeping their Virtue long, if kept in those Glasses, and wrapp'd in dry Silk, or such sort of Paper as will become electrical by rubbing ; for as often as they are expos'd to the Air, they will attract.

4. *Electricals per se* communicate their Virtue to any of the *Non-electrical*, when brought near them ; in which Case the *Non-electricals* attract and repel like
like

like the *Electricals per se*. Thus an Iron Bar suspended by a silken Thread, an Hair Rope, or a dry Cat-gut, when an excited *Electric per se* is brought near it, will both attack and send out its *Effluvia* to a *Non-electric* held near it; as appears in the Dark by the Light coming out at the End of the Bar.

5. An *Electrical per se* loses its excited Virtue in communicating to the *Non-electrical*; and the sooner, the more of those Bodies are near it. Thus in moist Weather the rubb'd Tube holds its Virtue but a little while, because it acts upon the moist Vapours that float in the Air; and if the rubb'd Tube be applied to Leaf-Gold or Brass, laid upon a Stand, it will act upon it much longer, and more strongly, than if the same Quantity of Leaf-Gold is laid upon a Table, which has more *Non-electrical* Surface than the Stand.

6. When a *Non-electrical* is suspended by, or only touches an *Electrical per se*, it receives the Properties of an *Electrical per se* from a rubb'd Tube or Wax, &c. This appears by the Fire that flashes from the Fingers of a Man suspended by Hair-Ropes, or who stands upon a Cake of Resin, when he has receiv'd Virtue from the rubb'd Tube.

7. The Virtue which a *Non-electrical* receives from a rubb'd Tube, runs on to the most distant Part of the suspended Body from the Place where the Tube is applied, and seems to be collected there, from whence it flashes in the Dark, snaps, and exerts its Attraction upon the Thread of Trial; though as the Virtue runs along, it sometimes shews itself in other Parts of the suspended *Non-electrical*.

8. If a *Non-electrical*, whilst it is receiving the Virtue from the rubb'd Tube, be made to communicate with the Floor of the Room, or any other great *Non-electrical* Body by a *Non-electrical* String, how small soever, (though but a Thread) the Virtue will not shew itself, as it did before, at the Extremities, where the Flash of Light was seen.

9. If a *Non-electrical* be ever so big, when suspended, it will receive Electricity from the rubb'd Tube. And if five or six hundred Foot long, when the rubb'd Tube is applied at one End, the Bodies hanging at the other End will become electrical. This has been tried by several People as well as myself.

10. If a long *Non-electrical* String be fasten'd to an *Electrical per se*, and extended to a great Distance, being supported by *Electricals per se* to keep it from touching the Ground, all Bodies fasten'd at the End of it will become electrical when the rubb'd Tube is applied at the other End, though the Tube does not touch it, but is only brought within two or three Inches of it.

N. B. This String we have before called the *Conductor of Electricity*, and the Cat-gut or silken Strings, Glass Tubes, or whatever kept the long String from touching the Ground, *Supporters*.

If any of the *Supporters*, mention'd in the last Observation, be chang'd for a *Non-electrical* Supporter, the Virtue will there be stopp'd and taken away by that *Supporter*: But if that *Supporter* be again supported by *Electricals per se*, it will only receive so much Electricity as will impregnate it, and then the
Virtue

Virtue will go on to the End of the String, and impregnate the Bodies fasten'd to it.

12. The *Non-electricals* receive the greatest Virtue at the End of the String, and most of all, if they are wet. But the *Electricals per se*, if long Bodies, as long Sticks of Wax, and Glas Tubes, only become electrical at the End next to the String.

13. *Electricals per se* will become *Non-electricals*, if they be wet, or only moisten'd. Thus Supporters that transmit the Electricity immediately, stop it when wet with a Sponge, or when blown through, if open Tubes. And if the long *Electricals per se*, hanging at the End of the Conductor, be made wet, they will become *Non-electricals*, and strongly receptive of the Virtue given by the rubb'd Tube at the other End of the String.

N.B. All the six Experiments mention'd in the Beginning of this Paper, confirm this Observation.

14. A *Non-electrical* having been impregnated with Electricity by the rubb'd Tube, is repell'd by it, till it has lost its Electricity by communicating it to another *Non-electrical*. Then being in its first State, it is again attracted by the Tube, which holds it till it has fully impregnated it; then it repels it again. This is evident, by attracting a Down Feather by the Tube in the Air, and then repelling it; so as to make it dance backwards and forwards to and from a Finger held up at a Foot or two from the Tube. But the Thing appears more plainly from the following

E X P E R I M E N T VII.

Having rubb'd the Tube *Tt*, (see TAB. I. Fig. II.) and with it attracted a Feather, the Feather at *t* was repell'd from the Tube, whenever it was brought near it; but suddenly dipping the End *T* of the Tube in Water, the Feather floating in the Air came to it again, and stuck to the End of the Tube at *T* or near *F*.

N. B. In fair Weather this Experiment will not succeed, unless the Tube be thrust pretty deep into Water (a Foot at least); but in moist Weather an Inch or two will do.

P. S. Though animal Substances be generally thought to be *Electrical per se*, yet it is only when they are very dry: This is the Reason why a living Man suspended by a Hair Rope, or standing upon a Cake of Resin, to receive Electricity from the Tube, must be consider'd as a *Non-electrical*, by reason of the Fluids of his Body.

N. B. The above Observations, together with the *Queries* in my former Papers, will be further illustrated by some Experiments which I do not now mention, because I have only try'd them at home; but when I have try'd them before the ROYAL SOCIETY, I shall give an Account of them in Order.

X. *An Account of some Electrical Experiments made at his ROYAL HIGHNESS the PRINCE of WALES's House at Cliefden, on Tuesday the 15th of April 1738. where the Electricity was conveyed 420 Feet in a direct Line. By the Same.*

HAVING heard that Electricity had been carried along an hempen String five or six hundred Foot long, but having only seen it when the String was carried backwards and forwards in a Room by Silk *Supporters*, I was willing to try it with a Packthread String stretch'd out at full Length; for which Purpose having join'd a Cat-gut String of six Foot long, I fasten'd it to the Inside of a Door in the Suite of Rooms at *Cliefden*; and having also tied another Cat-gut, like the first, to the other End of the String, I tied it up to the Inside of the Door at the other End of the House; but at the Place where the Packthread was join'd to the Cat-gut, I left a Foot and an half of Packthread hanging down, and fasten'd to it a *Lignum Vitæ* Handle of a Burning-Glass. Then applying a rubb'd Tube at the other End of the String, I made the Electricity run to the *Lignum Vitæ*, but with some Difficulty, which I attributed to the Size, being an animal Substance that still stuck to the Packthread as it was new; therefore I caus'd the Packthread to be wet with a Sponge from one End to the other, to wash off the Size: Then was the Electricity from the Tube communicated very soon and very strongly; for the

Thread of Trial (mention'd in my former Papers) was drawn by the *Lignum Vitæ* at the Distance of a Foot.

Afterwards having join'd more Packthread together, I made a String of four hundred and twenty Foot long, one End of which I fasten'd (by the Interposition of Cat-gut as before) to the Iron Gates in the Garden, before the House, and the End which had the *Lignum Vitæ* Handle, to the upper Part of the Door next to the Back-side of the House in a large Drawing-Room, taking care that the String came through the middle of the open'd Doors through which it pass'd; and to prevent this String dragging upon the Ground, three Pieces of Cat-gut held across by two Men, at equal Distances from the Ends, and from each other, supported it. The String was altogether dipp'd in a Pail of Water, before the Experiment; but great Care taken, that the Cat-gut should not be wet.

Then I applied the rubb'd Tube at the End in the Garden, whilst my Assistant held the Thread of Trial near the Handle above-mention'd, which Thread was strongly attract'd, though the Wind was very high, and blow'd in the contrary Direction to that in which the Electricity ran along.

I first tried the Experiment with the Packthread dry, but then it would not do at that Distance.

N. B. The Weather was moist when I made the Experiment.

XI. Observationes Botanicæ, *Plantarum quarundam Descriptiones accuratiores exhibentes*; per D^r Paulum Henricum Gerhardum Moehring, M. D. factæ; ad Illustrissimum D^{nu}. Hans Sloane, Bart. R. S. Præf. missæ.

I.

SALICORNIA *ramis clavatis, squamis articulorum adpressis.*

PLANTA annua, quoad omnes partes succulenta, 8. 9. digit. Rhenan. raro pedem Rhenan. alta.

RADIX e multis fibris filiformibus constat.

CAULIS ramosus, tereti-compressus parum, ad radicem lignosus & rugosus, supra succulentus, glaber, aphyllus, clavatus: *Clavis* oppositis, alterno ordine e productionibus auriculatis, squamatis, vaginantibus, arcte adpressis, caulis primarii erumpentibus, $\frac{1}{2}$, 1. ad $1\frac{1}{2}$ dig. Rhen. longis, suprema terminatrice reliquis longiore.

FRUCTIFICATIO e *Flosculis* ternis, figuram trianguli birectanguli sphaerici, cujus basis solum convexa est, repræsentantibus, alterno ordine sibi oppositis, constat. His fructificationibus triangularibus omnes clavæ secundum longitudinem oblitæ sunt.

Insidet cuilibet commissuræ ramulorum squamato-denticulatæ, subacutæ, *denticulo* inslar receptaculi totius fructificationis serviente, ac infima stamina occludente.

CALYX est productio scapi squamata, marcescens quocum unum planum efficit;

Flosculi superioris, & quasi intermedii, rhomboideus, angulo inferiori rectilineo acuto; Angulo superiori curvilineo obtuso;

Flosculorum duorum inferiorum, aut, si mavis, lateraliū, Trigonus, basi parum latiore.

COROLLA nulla.

STAMINA Duo, supra & infra germen opposito situ, ejusdem basi adfixa, & e rimula calycis prominula: Superius primum exsurgit; quo delapso, inferius prodit (Unde factum est, ut omnes Botanici unum modo stamen eidem adscribant).

Filamenta filiformia, intra calycem abscondita.

Antheræ oblongæ, erectæ, extra calycem hiantes, didymæ, (inde fit, ut primo subtiliori aspectu parvum corpus tetragonum præ se ferant) extrorsum concavæ, lateribus introrsum longitudinaliter convolutis, cum filamento æqualis longitudinis, eidem in summo utrimque adhærentes, arctèque illud obtegentes, basi sua plerumque intra foveolam calycis inclusæ. In concavitatem istam multum farinæ genitalis delabitur.

PISTILLUM, *Germen* subrotundo-acuminatum, in medio filamentorum situm, intra calycem absconditum, ejusdem cum filamentis longitudinis.

Stylus nullus. *Stigma* capillare, acutum.

PERICARPIUM *Capsula* vesicaria, inflata, ovato-acuminata, exacte referens calyptram polytrichi DILLENII, sed deorsum magis ampullatam, intra calycem latens.

SEMEN unicum, ovato-compressum, horizontaliter in capsula situm, a basi ad medium sulcatum, tenuissimi ope *pedicelli* costæ caulis adfixum.

OBSERVATIONES.

a. Crescit heic locorum ubique ad oceani Septentrionalis litus, dummodo terra pinguis, argillacea (nostratibus *Schlick* vocata) adsit, & magnis fluxibus maris aqua salina interdum conspergi possit. Simul ac vero terra aggere circumvallatur, & maris undis subtrahitur, sicque salis marini nutrimento privatur, frequenti statim anno disparet.

b. Adhibetur inter acetaria, refrigeranti sapore se commendans.

c. Floret *Augusto*, semina perficit *Septembri* & *Octobri*. Plantulæ prodeunt fine *Aprilis*, & initio *Maii*: His cotyledones tereti-oblongæ, succulentæ.

d. Ergo pertinet in *Systemate Sexuali* LINNÆI ad *Diandriam Monogyniam*.

(*e.*) Alia haut ita pridem species *Saltzdahlenfis*, *Ducatus* scilicet *Brunsvicensis*, nobis, siccis specimenibus, missa est a D. D. FRANC. ERN. BRUCKMANNO, quæ longe diversa a nostra, adpellari posset *Salicornia*, *ramis imbricatis pyxidatis, squamis articulorum exstantibus*, propositaque a variis auctoribus videtur.

(*f.*) Tandem, genus *Salicorniæ* a nullo hactenus Botanico curate satis enodatum fuisse patet, teste fragmento amicissimi LINNÆI *Charact. Gener. Plantar. & Hort. Cliffort.* sua enarrantis ex incompletis TOURNEFORTII ac MAGNOLII adumbrationibus.

II.

VERBASCUM *foliis cordatis crenatis acutis glabris:*
floralibus ternis.

PLANTA biennis, secundo anno florens, caule 7, 8, pedes alto.

CAULIS

CAULIS plerumque simplex, nonnumquam inferne ramosus, longissimus, erectus, teres, brevissimis pilis villosus, læte viridis, inferius valde foliosus, superius ab initio florum emergentium parvis foliolis stipatus.

FOLIA *primi anni* & *Caulis inferiora* sessilia, semiamplexicaulia, cordata, in acumen lanceolato-lineare acutum terminata, mollia, glabra, margine crenato, dentato: denticulis inæqualibus.

Floralia terna, lanceolato-linearia, acuta, parva, medio infimo duplo triplove longiori.

FLORES plerumque quaterni ex eodem sinu: in summo caulis unicus, reliquis suffocatis.

PEDUNCULUS brevissimus, calyce triplo fere brevior, crassius, simplex.

CALYX. *Perianthium*, ut in *Linn. gen. pl.* ad basin fere quinquepartitum: *laciniis* lanceolato-linearibus, hirsutis.

COROLLA. *Petalum*, ut *Linn. gen.* 153.

STAMINA. *Filamenta* 5. subulata, corolla brevior: *tribus superioribus* reliquis brevioribus, circumcirca lanuginosis: *duobus infimis* reliquis tertiam partem longioribus, declinatis, sursum incurvatis, in medio interni lateris lanuginosis.

Antheræ trium breviorum filamentorum triangulariter incumbentes, adpressæ, planæ, sexangulares: *duorum longiorum* filamentorum rectanguli figura incumbentes, adpressæ, planæ, sexangulares.

PISTILLUM *Germen* subrotundum. *Stylus* filiformis, inclinatus, staminibus parum longior, marcescens. *Stigma*, ut *Linn. gen.*

PERICARPIUM *Capsula* subglobosa, transversim a summo ad basin bisulcata, bilocularis, &c. ut *Linn. gen.*
In

Involucrum hujus exterius est calyx erectus, fructum amplectens.

SEMINA Numerosa, oblongo-quadrangularia, truncata, minutissime rugosa, parva. *Receptacula*, ut *Linn. gen.*

Obf. a. Ergo quoad plurimas fructificationis partes simillimum existit *Verbascum* quinto LINN. *Hort. Cliff.* p. 55. in reliquis differt.

b. Corollarum color flavus, unguibus maculatis, purpureis : filamenta interne purpurea : horum lanugo partim purpurea, partim alba.

c. Semina vere 1738. ab optimo LINNÆO titulo *Verbasci e Virginia* missa, cum plurimis aliis noviter ex *America* advectis, atque ad Illustr. Dom. GE. CLIFFORD transmissis, plantas modo descriptas largita sunt, quæ hyeme solo sub tecto conservandæ apud nos videntur.

(d.) Flos tota æstate matutinis horis apertus.

e. Ergo *Verbascum* annuum, foliis oblongis sinuatis obtusis glabris. LINN. *Hort. Cliff.* 55. melius circumscribetur hoc nomine : *VERBASCUM foliis oblongis sinuato-crenatis obtusis glabris, florali unico*. Cujus differentia specifica potissimum in his consistit : *Folium florale* ovato-acuminatum, unicum. *Flos* unicus. *Pedunculus* longissimus, filiformis, calyce triplo longior. *Calyx* sub fructu plano-expansus.

III.

SENECIO *foliis pinnatifidis lacinulatis : laciniis omnibus laxis patentissimis linearibus acutis.*

Jacobæa altissima, foliis crucæ *artemisiæve* similibus & æmulis. Rupp. Jen. 142.

E c

Caulis

Caulis humanæ altitudinis, teres, levissime angulosus, strigosus, glaber.

Folia alterna pinnatifida, glabra, laciniis æqualibus, linearibus, patentissimis, laxe lacinulatis, apicibus acutis, rachi lineari : color saturate viridis, inferiori parte parum pallidior.

Corollæ radii flavi, magni, mox revoluti.

Calycis in basi foliola reliquis adpressa.

Obs. *a.* Dixi hanc plantam, Jena missam, Senecionem, secundum characterem, a LINN. *gen. plant.* 647. datum.

b. Ergo specie diversa a LINNÆI Senecione foliis pinnato lyratis, lacinulatis. *Hort. Cliff.* 406.

IV.

ILLECEBRUM *Linn. Corollar. gen.* 947. *Rupp. Jen.* 79. *Corrigiola Dillen. Giss. Supplem. adpend.* 167.

CALYX *Perianthium* pentaphyllum, carnosum, *foliolis* crassis, erectis, compressis, introrsum ad summum fere excavatis, persistentibus, seta infirma terminatis.

COROLLA. Nulla.

STAMINA. *Filamenta* quinque triangulari-subulata, fructu breviora, intra calycem. *Antheræ* rotundulæ, erectæ, simplices.

PISTILLUM. *Germen* ovato-acutum, calyce dimidio fere brevius. *Stylus* nullus. *Stigma* simplex, turgidum, obtusum.

PERICARPIUM. *Capsula* membranacea, tenuissima, ovata, utrimque acuminata, simplex, univalvis, superne dehiscens, calyce testâ.

SEMEN. Unicum, ovatum, utrimque acutum, maximum, nitidum.

Obs.

Obs. a. Ergo pertinet in *System. Sexual.* LINNÆI ad *Pentandriam Monogyniam*, commodeque post genus 94. *Achyranthis* collocabitur.

b. Observatio tribus annis repetita hæc docuit, quum plantula humifusa copiose apud nos in arenosis humidis proveniat.

V.

RUPPIA foliis linearibus obtusis.

PLANTA aquis marinis innatans, flexuosa, perennis.

RADIX ramosa, fasciculos foliorum emittens; *corpus* teres, geniculatum, repens, brunnum, solidum, crassitie pennæ circiter columbinæ, aut parum tenuius; *fibrille* capillares simplices, e geniculis tantum prodeuntes, unciam unam alteramve longæ, albicantes.

Fasciculi caulini, culmi graminei specie, singuli e singulis radicalibus ramulis prodeunt, compressi, laxè geniculati, glabri, valde infirmi, flexiles, natantes, aquave marina refluyente, argillæ incumbentes, e quolibet geniculo vaginato, alterno ordine, ramos compositos emittentes.

Folia vaginantia, alterna, linearia, verticaliter obtusa, oblonge parallelogramma, glabra, mucosa, saturate viridia, basi geniculis caulinis infixæ, ramulos cum horum foliis, narcissorum instar, includunt. Versus extremitatem cujuslibet ramuli 2, 3, 4 folia, situ parallelo, unicæ vaginæ includuntur.

Foliis vaginatis omnibus fere, ipso caule longioribus, *fructificationes* ea quidem lege insunt, ut hæc in dimidia inferiori ejus parte intra rimulam compressam abscondantur. Supra & infra fructificationis

lineam geniculum transverse sulcatum est, hanc a petiolo infra, & a reliquo folio supra distinguens.

CALYX, *Involucrum universale*, *vagina spathæ* vices supplens, in dimidia inferiori folii parte, introrsum rima media longitudinali, cujus latus unum ab altero aliquantum obtegitur, hians.

Spadix intra involucrum, membranaceus, albidus, compressus, obtusus, lateribus longitudinaliter parum convolutis, medio leviter carinato, dorsum involucri spectans, longitudine $\frac{3}{4}$ involucri, aut parum longior, numquam hujus finem attingens, fructificationes 9. ad 13. distice in longitudine obliqua fovens.

COROLLA Nulla.

Filamenta nulla. *Antheræ* solitariae, ante florescentiam intra involucrum latentes, ovato-oblongæ, utrimque subacutæ, oblique adscendentes & distice secundum longitudinem spadici ita adhærentes, ut nunc unam, nunc duas antheras unicum pistillum eodem in plano excipere videatur, singulis tamen antheris singula pistilla vere adsint, modo abscondita, modoque visui obvia. At explicatæ, (i. e. durante florescentia) ab alis suis lateralibus, elasticis, membranaceis, pellucidis, expansis in figuram naviculæ concavam incurvantur, carina deorsum prominente, & pistillis ita superimponuntur, ut distracta utrimque, patulaque facta involucri rima, ima sui parte sursum horizontaliter adscendant, atque navicularum concavarum specie secundum longitudinem extrorsum pateant. Corpus antherarum flavum & mucosum est, quod facile abstergi potest.

PISTILLUM *Germen* intra involucrum, oblongum, ad basin, qua spadici adfigitur, parum amplius. *Stylus* intra involucrum, simplex, filiformis, sursum recurvus, per-

persistens, post florescentiam cum spadice parallelus, & parum curvus. *Stigmata* duo, tenuissima, capillaria, ab invicem diducta, extra involucrum horizontaliter exposita, cito marcescentia & evanida (ut relicta hinc macula e ferrugineo-nigricans facile alicui imponere possit, stigma modo unicum esse).

PERICARPIMUM; *Cortex* tenuis, membranaceus, cylindraceus, basi obtusus, apice stylo munitus, stylo parum longior, cum spadice parallelus, basi liber; ad finem styli spadici adfixus, pedicelli ope brevissimi.

SEMEN In quolibet cortice solitarium, cylindraceum, utrimque obtusum, longitudinaliter subtilissime striatum, album.

Ergo pertinet in LINNÆI *System. Sexual.* ad *Gynandriam Monandriam*, minime vero ad *Gynandriam Polyandriam* ejusd. *ibid.* In *fragment. meth. nat.* LINN. p. 506. *Classium plantar.* ad *ordinem XLVIII.* quo & *Naias*, & *Zannichellia* referendæ videntur: In ROYENI *System.* ad *Palmas*, *Spatha bifida*. Vid. *Ejusd. Flor. Leyd. Prodr.* p. 9.

Crescit in aqua marina ad insulam *Wangeroogensem*, & reliquas ad sinum illum Oceani Septemtrionalis, *Wadt* dictum, fitas insulas. Durante aquarum adfluxu, eidem innatat; refluxo autem mari, argillæ tenaci, cui radix infigitur, incumbit.

Mirum, plantam adeo vulgarem locis maritimis, cujus folia (quæ sicca, papyri instar, alba, nigra, etiam evadunt) mensibus Augusto & Septembri a maris fluctibus ad littora abundanti copia rejiciuntur, a nullo, quantum memini, nisi forte Anglo botanico, descriptam aut depictam esse. *Ruppia* generi inferenda videtur, si hujus character, amicissimo LINNÆO non nisi ad siccum exemplar, ut signum †, in *generibus*

bus plantar. adjectum docet, examinatus, parum ampliatur. An malint alii novum genus?

VI.

HIPPURIS. *Linn. gen. 1.*

Calyx, Nullus.

Corolla, Nulla.

Stamen, *Filamentum* unicum, subulatum, crassiusculum, deciduum, longitudine fere antherarum, germini insidens. *Anthera* didyma, quolibet segmento a tergo bisulcata, germine & filamento parum longior, crassa, carnosæ.

Pistillum, *Germen* oblongum, infra flamen. *Stylus* unicus, filiformis, tenuis, erectus, acumine extrorsum reflexus, introrsum ad latus staminis ex apice germinis oriundus, stamine longior, marcescens. *Stigma* acutissimum.

Pericarpium Nullum.

Semen Unicum, oblongum, nudum, duriusculo tegmine abscondens nucleum parvum.

Obs. 1. Floret Jun. & Jul. fructum perficit August. Septembr. crescit abunde in fossis *Jeveranis*, prope *Embdam Frisæ Orientalis*, &c.

2. Variat *staminibus rubellis*, quæ copiosior; & aliis locis *staminibus albidis*, herbaceis, quæ rarior.

3. Ergo margines illi, a LINNÆO *gen. 1.* sub calyce descripti, sunt veræ antheræ, nec aliud quidquam bona lente detegendum.

Vide

Vide TAB. I. Fig. A. B. C.

FIGURARUM, sub lente Muffchenbrœckiana a me
delineatarum, explicatio.

Fig. A. *Flos antice visus, ut filamentum adpareat.*

a. Filamentum.

b. b. Antheræ, antice visæ.

Fig. B. *Flos a tergo pictus, ut pistillum conspiciatur.*

c. c. Antheræ, postice visæ, ut sulci in conspectum
prodeant.

d. d. Germen.

e. Stylus cum stigmate.

Fig. C. *Semen.*

f. Semen fere maturum.

g. Stylus marcescens, supra semen reflexus.

XII. *Observatio Anthelii Vitembergæ spectati;*
per J. Fried. Weidlerum Mathes. Prof.
ibidem Primar. & R. S. Lond. Soc. com-
municata, in Epistola ad C. Mortimerum,
R. S. Secr.

DIE $\frac{18}{7}$ Januarii A. 1738. quidam ex auditori-
bus meis, cum ante meridiem in campo prope
Vitembergam agros dimetiretur, forte fortuna Anthel-
ium, sive Solis imaginem e regione Solis veri versus
septentrionem positam conspexit. Nimirum mane
hora 8 cœlum undique serenum, mox circa horam
9, e septentrionali plaga, nubes exoriuntur, ibique
sensim

fenſim & paulatim condenſantur, temporis progreſſu hæ in meridiem ulterius ſeſe explicabant. Hora 9. min. 30. cum nubes obſcuræ fere verticem attingent, apparuit in illis Sol Soli oppoſitus, pari magnitudine, rotundus, admodum ſplendidus, ut oculi ejus lucem ferre non poſſent, corona ſive halone ovali cinctus. Diameter coronæ major, Solis circiter diametros quinque, minor tres capiebat: Ipſa corona rubro flavoque coloribus exornata, parte rubra in Anthelium verſa: Tractus nubium, reliquus intra coronam flaveſcebat, hinc inde etiam rubebat. In Anthelio decuſſatim ſeſe ſecabant duæ iridis portiones, ſub angulo 60 fere graduum, utrimque in ortum & occaſum flexæ, & ad coronæ ovalis peripheriam continuatæ: Quales A. 1661. D. 6. Sept. *Hevelius* quoque cum Anthelio vidit, quemadmodum in tractatum de Mercurio ſub Sole p. 176. narrat. Durabat ſpectaculum per horæ quadrantem; cum enim nubes in meridiem longius extenderentur, & Solem verum occultarent, Anthelius evanuit. Ningit poſtea parum hora undecima: Mane lenis ventus ex media inter meridiem & occaſum plaga ſpirabat. En figuram ab ipſo ſpectatore mihi exhibitam, in
 TAB. II. Fig. I.

XIII. *Occultatio* Palilicii, A. 1738. d. 23.
 Decembris St. N. *observata* a D. Christ-
 fried Kirchio, *Astronomo Regio*, Berolini. *Ex*
litteris ad J. F. Weidlerum datis excerpta.

Tempus horolog. oscillat. H. M. S.				Partes microm. Tubo l. ped.	Valor partium microm. " "	Tempus correc- tum. H M S	Tempus correc- tius. H. M S.
1	6	37	* a centro <i>M. Sinai</i>	38	15 21	6 24 37	
2	6	30	* a centro <i>M. Sinai</i>	34	13 42	26 30	
3	7	3 54	Immerfio stellæ			6 31 54	6 32 00
4	8	5 29	Emerfio stellæ tub. 9 ped			7 33 29	7 33 33
5	5	35	Emerfio certo facta			7 33 35	
6	6	43	* a centro <i>M. Sinai</i>	36	14 32	34 43	
7	15	32	* a prox. marg. Lunæ	8	3 14	43 32	
8	20		* a <i>M. Sinai</i>	46½	18 47	48	
9	28		Diameter Lunæ	74	29 73	56	
			vel	73½ }	29 41		
10	29	12	<i>M. Sinai</i> a prox. marg. ☾	8	3 14	7 57 12	
11	38		Diameter ☽ sub. 9 ped.	99½	29 38	8 6	
12	42		Diameter ☽ sub. 7 ped.	75	30	10	
13	46	55	* a <i>M. Sinai</i>	72	29 5	14 55	
14	48		Diameter Lunæ	73½	29 41	8 16	

Vide SCHEMA hujus Occultationis in TAB. II. Fig. 2.

*Situs stellæ respectu macularum lunarium sequenti
 modo observatus.*

I. Ante observationem (1.) h. 6. 20'. notavi stel-
 lam in linea recta a meridionali margine Insulæ
 Macræ (Posidonii) per septentrionalem partem Ponti
 Euxini, (medium maris Serenitatis) & M. Ætnam
 (Copernicum) producta: & linea a M. Sinai ad stel-
 lam fere stringebat littus sinus Sirbonidis. (M. Hu-
 morum).

II. Tempore observationis, (1.) stella erat in linea recta a lacu nigro majore (Platone) per partes orientales insulæ Cercinnæ (a Keplero versus ortum) producta.

III. Tempore observationis (2.) stella in linea per medium Paludis Mæotidis & medium M. Adriatici (per M. Crisium & S. medium) continuata.

IV. Tempore immersionis stellæ, sequentes lineæ rectæ ad illam coincidebant, & locum peripheriæ lunaris, ubi stella occultabatur, designabant.

1. A littore Pontus Euxini (M. Serenitatis) versus Cæciam spectante, per M. Ætnam (Copernicum).

2. A littore sinus Apollinis, per loca paludosa (sc. a littore S. Iridum, per Keplerum).

3. A M. Sinai (~~Tychone~~) per littus meridionale S. Sirbonis (M. Humorum).

V. Emerfio stellæ contigit e regione M. Paropamisii, (Furnerii) & in linea recta a lacu nigro majore (Platone) per Byzantium (Menelaum) producta, quæ stringebat sinum extremum Ponti (M. Nectaris).

VI. Tempore observationis (7.) M. Porphyrites, (Aristarchus) margo septentrionalis L. Thespitis (Fracastorii) & stella in linea recta.

VII. Tempore observationis (8.) Lacus Hyperboreus superior (Hermes) medium Paludis Mæotidis (M. Crisii) & stella in linea recta.

Occultatio Palilicii observata Vitembergæ Saxonum,
d. XXIII. Dec. *St. N. A.* CIO DCC XXXVIII. a Jo.
Friderico Weidlero, R. S. Lond. S. &c.

Immersio	6.	27.	35.
Emersio	7.	29.	20.
Duratio	I.	I.	45.

ANNOTATIONES.

1. Observatio a duobus spectatoribus simul perfecta; ego tubo astronomico ix pedum utebar, amicus & socius observationis per telescopium iv pedum lunam contuebatur.

2. Immersio & emersio facta in instanti: uno tamen prope minuto horario citius per longiorem, quam per breviorum tubum animadversa.

3. Appulit stella ad marginem lunæ orientalem, circa gradum 163. schematis lunæ plenæ mobilis Heveliani, Selenographiæ, p. 364. emergebat circa gradum 272. ejusdem schematis. Itaque linea recta, puncta immersionis & emersionis copulans, stringit extrema maris Humorū & Nubium & inter Pitatum & Mare Nubium transit.

Cælum tempore immersionis serenum non erat, sed tenues nubeculæ semper fere ante lunam & stellam oberrabant: ideoque figura stellæ oblonga, diu ante occultationem, per atmosphæræ vapores spectabatur,

XIV. *Eclipsis Solis observata Vitembergæ Sax-
 onum, die IV. Aug. St. N. die XXIV. Julii
 St. Vet. A. CIOCCCXXXIX. post merid. a
 Jo. Friderico Weidlero.*

Phases crescentes.

		Hor.	Min.	Sec.	p. m.
Initium	.	4.	15.	30.	
Digitus I.	.		22.	00.	
Digiti II.	.		29.	30.	
III.	.		35.	30.	
IV.	.		40.	00.	
V.	.		47.	30.	
VI.	.		55.	40.	
VII.	.	5.	2.	00.	
VIII.	.		9.	00.	
IX.	.		24.	40.	

Phases decrescentes.

VIII.	.	5.	35.	30.	
VII.	.		43.	40.	
VI.	.		50.	30.	
V.	.		56.	00.	
IV.	.	6.	2.	45.	
III.	.		8.	40.	
II.	.		14.	00.	
I.	.		20.	45.	
Finis	.		27.	20.	

Vide Typum hujus Eclipsæ ad Fig. 3. TAB. II.

Ad FIGURAM 4. TAB. II.

Observatio Immerſionis & Emerſionis macularum, quæ tempore eclipſeos in diſco ſolis conſpicuæ fuerunt.

IMMERſIONES.		H.	M.	S.
Appulſus Lunæ ad maculam	(a)	4.	34.	35.
Tegitur tota macula	(a)	4.	34.	45.
Appulſus Lunæ ad maculam	(d)	5.	1.	30.
—————ad maculam	(e)	5.	5.	20.
—————ad maculam	(b)	5.	7.	15.
Immerſio totalis	(b)	5.	10.	00.
Appulſus Lunæ ad maculam	(c)	5.	16.	30.
Tegitur tota macula	(c)	5.	18.	00.

EMERſIONES.				
Incipit emergere macula	(b)	5.	30.	50.
Medium emerſionis	(b)		32.	30.
Emerſio totalis	(b)		34.	00.
Emerſio incipiens maculæ	(c)		39.	00.
Medium emerſionis	(c)		39.	50.
Emerſio totalis	(c)		40.	40.
Emerſio incipiens	(a)		41.	00.
Emerſio totalis	(a)		41.	40.
Emerſio	(d)	6.	4.	30.
Emerſio	(e)		6.	15.

ANNOTATIONES.

1. FIGURA 3. TAB. II. Siftit ſolis diſcum recto ſitu, qualem helioſcopium foris adſpicientibus oſtendit.

2. FIGURA

2. FIGURA 4. TAB. II. Repræsentat maculas solis eo situ, quem sub principium deliquii habuere, quarum immersio & emerſio durante eclipsi obſervata fuit.

3. Luna ſubiit ſolem circa gradum 102. a Zenith computatum: diſceſſit a ſole circa 53. gradum, ab eodem Zenith numeratum.

4. Tempore maximæ obſcurationis lunæ orbis non plane niger, ſed puniceo colore tinctus per teleſcopium apparuit. Maculæ tamen lunæ diſtingui non poterant.

5. Margo lunæ, parte finiſtra, quæ in meridiem vergebat, circa tempus maximæ obſcurationis, montium jugis diſtinguebatur, qui etiam in imagine, per teleſcopium picta, cernebantur. Reliquus margo ſub ſole conſpicuus æqualis.

6. Durante tota eclipsi Lunæ peripheria nuda apparuit, abſque nebula, vel nube, quæ in aliis quandoque eclipsibus eidem imminet. Circa finem tamen, cum unus circiter ſolaris diſcum digitus adhuc occultaretur, motus lucis ſolaris vehemens in margine Lunæ aſpero notabatur.

7. Denique prætermittendum non duco, quod amicus, harum rerum probe gnarus, qui per Teleſcopium Aſtronomicum ix pedum ſolem intuebatur, circa hor. iv. 31 min. in obſcuro Lunæ diſco lucem aliquam, inſtar fulguris, celeriter huc illuc in tenebris diffuſam, animadverterit: & quod idem obſervator circa horam v. min. 50 toti adſtantium coronæ affirmaverit, a ſe tum ter talia fulgura ſubito cñitentia iterum conſpecta fuiſſe.

XV. *Part of a Letter from Mr. J. Derby to Mr. Henry Sheppard, concerning a terrible Whirlwind, which happen'd at Corne Abbas in Dorsetshire, Oct. 30. 1731. communicated to the ROYAL SOCIETY by Edmund Halley, LL. D. V. Pr. R. S. and Astronom. Reg.*

— **O**N *Saturday* the 30th of *October* last past, about a Quarter before One in the Night, there happen'd at *Corne-Abbas, Dorsetshire*, a very sudden and terrible Wind Whirl-puff, as I call it: Some say it was a Water-spout, and others a Vapour or Exhalation from the Earth; but be it of what Name it will, it began on the South-west Side of the Town, carrying a direct Line to the North-east, crossing the Middle of the Town in Breadth two hundred Yards. It stripped and uncovered tiled and thatched Houses, rooted Trees out of the Ground, broke others in the midst of at least a Foot square, and carried the Tops a considerable way. The Sign of the new Inn, a Sign of five Foot by four, was broke off six Foot in the Pole, and carried cross a Street of forty Foot Breadth, and over an opposite House, and dropp'd in the Backside thereof. It took off and threw down the Pinacles and Battlements of one Side of the Tower; by the Fall of which, the Leads and Timber of great Part of the North Alley of the Church was broke in. The Houses of all the Town were so shock'd, as to raise the Inhabitants; no hurt was done but only
across

across the Middle of the Town in a Line. No Life lost, but Three had a very providential Escape. 'Tis computed by judicious Workmen, that the Damage sustain'd by this Accident amounts to Two hundred Fifty-eight Pounds, and upwards. It is very remarkable, it only affected, as I have related: no other Parts of the Neighbourhood or Country so much as felt or heard it. It is supposed by the most Judicious, that it began and ended within the Space of two Minutes. 'Twas so remarkably calm a Quarter after Twelve, that the Exciseman walked through two Streets, and turned a Corner, with a naked lighted Candle in his Hand, unmolested and undisturbed by the Air; and as soon as over, a mighty Calm, but soon followed by a prodigious violent Rain. If this Fact be worth relating, I should be glad to know amongst the Learned, what it might be called, or, if to be known, from what Cause it might arise.

Mintern Magna,
Nov. 13. 1731.

*Your obliged Friend,
and most humble Servant,*

J. Derby!

XVI. *An Account of Letters found in the Middle of a Beech, by J. Theod. Klein, Secretary of Dantzick, F. R. S. communicated to the ROYAL SOCIETY by Sir Hans Sloane, Bart. Pr. of the R. S. and Physician to His MAJESTY, &c. Translated from the Latin by T. S. M. D.*

IN the Year 1727. a *Beech-tree* was fell'd near *Elbing*, for the domestic Use of *John Maurice Møller*, then Post-master of *Elbing*, now Secretary of his native City. The Trunk being saw'd into Pieces, one of these, three *Dantzick* Feet six Inches long, cleft in the House on the 30th of *June*, discovered several Letters in the Wood about one Inch and a half from the Bark, and near the same Distance from the Centre of the Trunk. The Hewer, having at one Stroke unfolded such a Prodigy, and believing there was Witchcraft at the Bottom of it, ran in all possible Haste for his Master: But this Gentleman, well instructed in sound Philosophy, gave Orders to preserve the Pieces of Wood, and had them brought to my Study, at the same time communicating to me the History, and his Sentiments thereon.

Figure 5. TAB. II. exhibits the Letters conspicuous in the solid Wood, two of which, DB, shew their old Bark smooth and sound. The Wood lying between the Letters and the Bark of the Trunk, as well as that between the Letters and the Heart of the Tree, is likewise solid and sound, bearing not the least

G g

Trace

Trace of Letters. The Characters *g* *Q*, being somewhat hollow, receive the Bark of the Letters *D B* *.

The same Letters are seen in the Bark of the Tree, only that they are partly ill-shaped, partly almost effaced, whereas those within bear a due Proportion, as if done with a Pencil.

Now should it be ask'd after what manner these Letters reach'd the Middle of the *Beech*? and how it came to pass, that two of them, and no more, had their old dry Bark sticking to them?

Both these Queries are answer'd by the Vegetation of Plants. But as this is not a proper Place to expound it, I will suppose it known, and thus briefly complete the Affair.

'Tis an ancient Custom to cut Names, and various Characters, on the Rinds of Trees, especially on such as are smooth. That this has happen'd to our *Beech*, the mere Inspection of the Bark commands our Affirmation †.

An Incision made, the *Tubuli* conveying the nutritious Juice, and the *Utriculi* in which it is prepared, are divided and lacerated, and more of them, as the Incision was made deeper and wider: and consequently the Sap is not carried on in the Circulation, but extravasated and stopped at the Wounds. Hence the Origin of the Characters in the Bark and Wood.

* *Daniel Barckholtz*, formerly *Cæsarean* Poet Laureat.

† The Characters, besides *D B*, mark the Names of a noble Family, to which the Land, whereon the Tree was fell'd, formerly belong'd: *Regina*, *Dorothea*, *Michael*, *Gertrude*, *Joannes*, *Helwingii*.

Now as a new Circle of *Fibres* grows yearly on the Tree between the Wood and Bark, 'tis not impossible but a Number of these should in a Process of Years more and more surround the ingraven Characters, and at length cover them. And this Number was the greater in our *Beech*, on account of better than half a Century elaps'd since the Incision, which was made in the Year 1672. as appears on the Outside of the Bark, as may be seen in the Figure. But while new Circles of *Fibres* are successively added, the *Tunicle* or Skin of the Bark is broken each Time, and the *Utriculi* extended and dilated.

Wherefore 'tis easy, from what has been said, to draw the Reason, why the Bits of Bark cut off on all Sides, in the Letters D B, had the same Fate with the Letters; why the Wood between the Bark and Letters was solid and sound; and why the Shapes of the Letters bore a just Proportion in the Middle of the Wood, and not in the Bark.

So much for our *Beech*.

Now let us see, in few Words, what Authors say of such figured Woods.

Solomon Reifelius, of *Letters found within the very cleft Trunk of a Beech*, *Eph. Nat. Cur. Dec. 1. An. 6. Obs. 4.* has at length, though with some Difficulty, guess'd the genuine Cause from frequent Examples of Incisions.

But *Joannes Meyerus*, on a *Thief hanging from a Gibbet, drawn by Nature's Pencil in a Beech*, *Eph. N. C. Dec. 3. An. 5. Obs. 29.* and *Joannes Petrus Albrechtus*, on a *certain rare Figure seen in a Beech*, *Eph. ibid.* ascribe it to a Sport of Nature, and give this Reason; because they could not discover the

least Sign of Imposture, the deep Situation of the Figures hindering them from having any Suspicion on that head.

On the contrary, *Luke Schræckius*, on figured Beech-wood, *Eph. N. C. Dec. 3. An. 7, 8. Obsf. 118.* follows *Reiseli*'s Opinion; and being vers'd in *Malpighi*'s Anatomy of Plants, writes: "No wonder, if Figures cut in a young Tree, by the Length of Time, and the Accretion of many Barks, appear at last about its Middle, when grown old."

John Christopher Gottwald, on a crucified Man drawn by Nature in the Middle of a Beech-trunk *, *Eph. N. C. Dec. 3. An. 9. Obsf. 158.* accusing Nature's simple Violence, or a Disease of the Tree, is corrected by the most celebrated *John James Scheuchzer*, in his *Itinera Alpina*, Tom. 3. pag. 414. and in his *Herbarium Diluvianum*, p. 46. of a little Man in Beech-wood, *Tab. X.* where he makes mention of other Instances.

John Melch. Verdries is of the same Sentiment, treating of a Figure found in the Middle of a Beech, *Eph. N. C. Cent. 3 & 4. Obsf. 89.*

There remains, to my Knowledge, the Figure of a Chalice with a Sword perpendicularly erect, and on its Point sustaining a Crown, found in the Heart of a Piece of Wood at the Hague; which the Authors of the Collections of *Breslaw* exhibit to us "as a singular Phenomenon, worthy of being compared to *Aldrovandus*'s *Guaiacum*-tree, and figured Stones, if no Optic Fallacy, Error of Judgment,

* This Wood is kept in the Library of the Council of *Dantzick*.

“ artificial Fissure of the Wood, or other such Deceit,
 “ intervene.”

In fine, the Case is thus: Such as were wont to be frightened with Hobgoblins from their Infancy, hear the Rustling of Phantoms a great way off, and see them walk at Noon-day; while others, who have learned to inquire into the Causes of Things, are by those accounted dull of Sight and Hearing.

XVII. *Part of a Letter from Sir John Clark, one of the Barons of His MAJESTY's Exchequer in Scotland, and F. R. S. to Rog. Gale, Esq; Tr. R. S. Nov. 6. 1731.*

— I Was lately in *Cumberland*, where I observed three Curiosities in *Whinfield-Park*, belonging to the Earl of *Thanet*. The first was a huge Oak, at least sixty Foot high, and four in Diameter, upon which the last great Thunder had made a very odd Impression; for a Piece was cut out of the Tree about three Inches broad, and two Inches thick, in a strait Line from Top to Bottom. The second was, that in another Tree of the same Height, the Thunder had cut out a Piece of the same Breadth and Thickness, from Top to Bottom, in a spiral Line, making three Turns about the Tree, and entering into the Ground above six Foot deep. The third was the Horn of a large Deer found in the Heart of an Oak, which was discovered upon cutting down
 the

the Tree. It was found fixed in the Timber with large iron Cramps; it seems therefore, that it had at first been fastened on the Outside of the Tree, which in growing afterwards had inclosed the Horn. In the same Park I saw a Tree thirteen Feet of Diameter.

Remarks by the *Publisher*.

THIS Horn of a Deer found in the Heart of an Oak, and that fastened with Iron Cramps, is one of the most remarkable Instances of this kind, it being the largest extraneous Body we have any-where recorded to have been thus buried, as it were, in the Wood of a Tree. If *Joannes Meyerus*, and *Joannes Petrus Albrechtus*, (p. 233.) had seen this, they could not have imagined the Figures seen by them in Beech-trees to have been the Sport of Nature, but must have confessed them to have been the Sport of an idle Hand. To the same Cause are to be ascribed those Figures of *Crucifix's*, *Virgin Mary's*, &c. found in the Heart of Trees; as, for Example, the Figure of a *Crucifix*, which I myself saw at *Mastricht*, in the Church of the *White Nuns* of the Order of *St. Augustin*, said to be found in the Heart of a Walnut-tree upon its being split with Lightning. And it being usual in some Countries to nail small Images of our Saviour on the Cross, of *Virgin Mary's*, &c. to Trees by the Road-side, in Forests and on Commons; it would be no greater a Miracle to find any of these buried in the Wood of the Tree, than it was to find the Deer's Horn so lodged.

Sir *Hans Sloane*, in his noble *Museum*, hath a Log of Wood brought by Mr. *Cunningham* from an Island in the *East-Indies*, which, upon being split, exhibited these Words in *Portuguese*, DA BOA ORA. i. e. Det [*Deus*] bonam Horam.

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TAB. I.

Fig. 1.

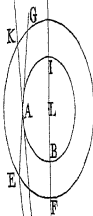


Fig. 2.

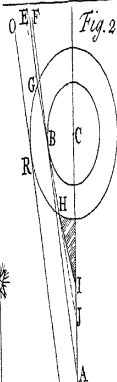


Fig. 4.

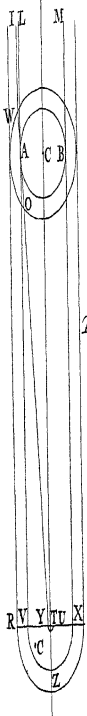
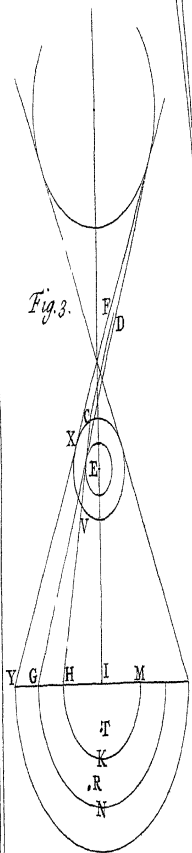


Fig. 3.



TAB. II

Fig. 1.



Fig. 2.



Fig. 4.



Fig. 6.

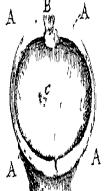
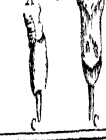


Fig. 7.



Fig. 8.



PHILOSOPHICAL TRANSACTIONS.

For the Months of *November* and *December*, 1739.

The C O N T E N T S.

- I. *A Letter from his Excellency Nicolas-Michael d'Aragona, Prince of Cassano, and F. R. S. to the President of the ROYAL SOCIETY, containing an Account of the Eruption of Vesuvius in May 1737. Translated from the Italian by T. S. M. D. F. R. S.*
- II. *An Abstract of a Letter from an English Gentleman at Naples to his Friend in London, containing an Account of the Eruption of Mount Vesuvius, May 18. and the following Days, 1737. N. S.*
- III. *De Atmosphæra Lunari, Dissertatio Astronomica. Auctore D^{no} Johanne Paulo Grandjean de Fouchy, in suprema Galliæ Rationum Curia Senatore, & Reg. Scient. Acad. Paris. Socio.*
- IV. *A*

THE CONTENTS.

- IV. *A Narrative of an extraordinary Sinking down and Sliding away of some Ground at Pardines near Auvergne, sent from M. T— to a Relation in England, translated from the French, and communicated to the ROYAL SOCIETY by Phil. Henry Zollman, Esq; F. R. S.*
- V. *A Dissertation on the Worms which destroy the Piles on the Coasts of Holland and Zealand, by Job Baſter, M. D. F. R. S. communicated by the President of the ROYAL SOCIETY. Translated from the Latin by T. S. M. D. F. R. S.*
- VI. *Two Observations of Explosions in the Air; one heard at Halsted in Essex, by the Rev. Mr. A. Vievar, Minister of that Place; the other by Sam. Shepheard, Esq; of Springfield in the same County.*
-

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- I. *A Letter from his Excellency Nicolas-Michael d'Aragona, Prince of Cassano, and F. R. S. to the President of the ROYAL SOCIETY, containing an Account of the Eruption of Vesuvius in May 1737. Translated from the Italian by T. S. M. D. F. R. S.*

S I R,

AS your extraordinary Talents, and excellent Taste, in a true Examination of Natural Effects, and in Discoveries relating to Experimental Philosophy, are so well known, that you have, with Justice, been elected into the most celebrated Academies of *Europe*, and to the Presidentship of the ROYAL SOCIETY of *London* in particular; I resolved, with good Reason, to offer you a short Account of the last great, dreadful and pernicious Eruption of our *Vesuvius*; to the End that, if you are pleased to investigate the Causes thereof, the Republic of Letters might reap some general Advantage, as it does daily, by means of its Members of the first Rank in Merit.

Mount *Vesuvius* is generally esteem'd about seven Miles distant from *Naples*. It rises in the Middle of a large Plain, which surrounds it on every Side. It is better than four Miles from the Sea; and the Foot of the Mountain is seen to begin from the Sea-Coast, which growing gradually higher, reaches the first Plain, to which one can easily ride on Horseback. The Figure of the Plain is almost circular, being about five Miles in Diameter, and half a Mile

perpendicular Height above the Level of the Sea. This is the Basis of the Mountain, out of which arises another, called by the People of the Country *Monte vecchio*, whose perpendicular Height is about four hundred Paces, and its Top little less than two Miles in Circumference, of an irregular Figure. The said Top, before the Year 1631. was of the Form of a Bason, but all surrounded with aged Oaks, and vastly large Chestnut-trees, whose Fruit afforded Food sufficient for a Number of Cattle that fed thereon. In the Bottom a Cavern was observed, into which People descended above two hundred Paces, by difficult and interrupted Paths; and this Opening was looked upon as the ancient Mouth, which for a long Space of Time had constantly cast up great Quantities of bituminous Matter, and had at the same time burnt a considerable Part of the neighbouring Country, cultivated by the Inhabitants round the Hill.

Concerning the Eruptions that have happened heretofore, they are very numerous, as well ancient as modern.

Of the first, several are taken Notice of by *Berosus Chaldaeus*, *Polybius*, *Strabo* in the time of *Augustus*, *Diodorus*, and *Vitruvius*; and in *Trajan's* Reign the Name of the Mountain became more famous by the Death of *Pliny*. From that time forward, 'tis not doubted, that the Eruptions were less frequent down to the Year 1139; when, after a considerable Eruption, it began to take Rest, and continued quiet somewhat less than five Centuries; so that the horrid Remembrance of the past Ruins was pretty well obliterated out of the Minds of the
neigh-

neighbouring Inhabitants; who, vainly flattering themselves with Hopes, that the inflammable Matter was spent, planted the whole District round the Mountain, which, by its Fertility, became the Delight of these Parts. But, in Process of Time, they found themselves deceived and frustrated in their Expectations: For in the Year 1631. during six Months Space, continual Rumbings were heard, and Shocks of Earthquakes felt: And afterwards, in the Month of *December*, a dreadful fiery Eruption happen'd, which first blew up Part of the Mountain into the Air, in a terrible Manner, and then vomited out Water, Ashes, Stones and Fire; inundating almost the whole Country around, to the Sea, and for above seven Miles in Breadth, with the irreparable Loss of more than four thousand People. After which the Mountain became silent, and remain'd considerably diminish'd in its Height, from what it had been before.

It continued quiet for twenty-nine Years; but having rekindled in 1660. its Fire fill'd the whole Capacity of the immense Hollow, which remain'd since the Year 1631; whence, after several lesser Eruptions, a new Mountain appear'd in 1685.

In 1707. not only the Inhabitants of the Neighbourhood, but also the whole City of *Naples*, were put into great Terror, and not without Reason, by the Apprehensions of a Renewal of the dismal Tragedy of 1631. upon account of the frequent Noise and Shocks, the Fire seen on the Top of the Mountain, with a vast Quantity of Ashes, which issuing out with Impetuosity, were dispersed all over our Hemisphere, and darken'd the Light of the Sun for one

H h 2

whole

whole Day's Space. These were all manifest Signs of the impending Desolation : and yet (whether by a Miracle of our particular Protector St. *Januarius*, as some were of Opinion, or by natural Causes) this dreadful Day, which had portended so much Mischief, was beyond Expectation, and to our great Astonishment, follow'd by another as pleasant as could be desired : for the Air was quite serene, and clear of the Ashes ; and on the Mountain there was no other Appearance but that of a little Smoke.

In the Year 1724. the Quantity of Ashes and Stones, thrown from the Top of the Mountain, were so heaped from the Bottom up to the Edge of the old Mountain, that the whole Space from the old Hill to the new, appeared but one continued Mountain.

In 1730. there was another Eruption of *Vesuvius*, which, though very inconsiderable in respect of the last, yet was the Occasion of much Fear.

This present Year 1737, to the Month of *May*, the Mountain was never quiet : Sometimes emitting great Quantities of Smoak, at other times red-hot Stones ; which, for want of a sufficient impelling Force, fell on the same Mountain. But in order to a clear Idea of all the Circumstances prefiging the impending Eruption, 'tis requisite to know, that in the Beginning of *May*, a Smoak only was seen to issue from the open Mouth at the Top ; and from the 16th to the 19th, subterraneous rumbling Noises were heard.

On the 19th, Fire was seen to burst out in thick black Clouds ; and the same Day there were several loud Reports, returning quicker towards the Evening :

ing: And still more on *Sunday* Night, when there constantly appear'd a very great Smoak mix'd with Ashes and Stones; and the Neighbourhood felt some Shocks, like those of a weak Earthquake.

On *Monday* the 20th, at the 13th Hour, the Mountain made so loud an Explosion, that the Shock was strongly felt not only in the Neighbourhood, but also in the Cities twelve Miles round. Black Smoak, intermixt with Ashes, was seen suddenly to rise in vast curling Globes; which spread wider, as it moved farther from the Bason. The Explosions continued very loud and frequent all this Day, shooting up very large Stones through the thick Smoak and Ashes, about a Mile high, to the Horror of the Beholders, and Danger of all the neighbouring Buildings.

At the 24th Hour of the same *Monday* 20th of *May*, amidst the Noise, and dreadful Shocks, the Mountain burst on the first Plain, a Mile distant obliquely from the Summit, and there issued from the new Opening a vast large Torrent of Fire; whence, by the Quantity of Fire incessantly thrown up into the Air, at a Distance all the South Side of the Mountain seem'd in a Flame. The liquid Torrent flow'd out of the new Vent, rolling along the Plain underneath, which is above a Mile long, and near four Miles broad; and in its Way it spread very speedily near a Mile wide; and by the fourth Hour of the Night, it reached the End of the Plain, and to the Foot of the low Hills situate to the South. But as these Hills are rugged with Rocks, the greatest Part of the Torrent ran down the Declivities between these Rocks, and into two Valleys; falling
suc-

ſucceſſively into the other Plain, which forms the Baſis of the Mountain; and after uniting there, it divided into four leſſer Torrents, one of which ſtopp'd in the Middle of the Road, a Mile and half diſtant from the *Torre del Greco*. The ſecond flow'd into a large Valley. The third ended under the *Torre del Greco*, near the Sea; and the fourth at a ſmall Diſtance from the new Mouth.

The Torrent which flowed into the Valley, ran as far as between the Church of the *Carmelites* and that of *the Souls of Purgatory*, by the 8th Hour on *Tueſday*. The Matter of the Torrent ran like melted Lead: In eight Hours it made four Miles; and conſequently, it flowed half a Mile in an Hour: A new and remarkable Circumſtance of this Eruption, ſeeing *Bulifone* thought it very ſtrange, that in the Eruption of 1698, ~~the Torrent~~ had advanced ſixty Paces in an Hour; whence he infers, that ſuch great Swiftneſs proceeded from a greater Degree of Liquefaction of the Matter. The Trees, which the Torrent light on in its way, upon the firſt Touch took Fire, and fell under the Weight of the Matter.

The Torrent which ran behind the Convent of the *Carmelites*, after ſetting the little Door of the Church on Fire, entered not only therein, but alſo through the Windows of the Veſtry, and into two other Chambers. In the Refectory, it burnt the Windows; and, what is ſurpriſing, the Glaſs Veſſels, that ſtood on the Tables, were melted into a Paſte by the violent Heat of the Fire. Sixteen Days afterwards, the Matter continued hot, and was very hard, but it was broke by repeated Blows.

A Piece of Glas fasten'd on the Top of a Pole (and thrust into this Matter) was in four Minutes reduced to a Palle. Under the Mais of the Torrent were heard frequent Reports, which made the Church shake, as if by an Earthquake. Along the whole Surface of the Torrent, there appear'd small Fissures, out of which issued Smoak, that stunk of Brimstone mix'd with Sea-water; yet these Exhalations are not poisonous, but rather a Remedy for some Diseases. The Stones round about these Fissures were observed to be covered with sublimed Salts, the Nature of which I shall explain hereafter.

Iron, thrust into these Fissures, was taken out moist; but upon thrusting in Paper, it was not moisten'd, but rather somewhat harden'd.

At the same time when the new Mouth open'd, that on the Summit of the Mountain vomited a vast Quantity of burning Matter, which, dividing into Torrents, and small Streams, ran partly towards the *Salvadore*, and partly towards *Ottajano*; and at the same time that this Matter issued out, red-hot Stones were seen to be cast out of the Mouth, in the midst of black Smoak, frequent Flashes of Lightning and Thunder, all produced by the same Matter.

These impetuous Expulsions of Fire continued till *Tuesday*, when the Eruption of the melted Matter, the Flashes, and thundering Noise, ceased; but a strong South-west Wind arising, the Ashes were carried in great Quantities to the utmost Boundaries of the Kingdom; in some Places very fine, in others as coarse as *Ischian* Sand: And in the Neighbourhood they not only felt this plentiful Shower of Ashes,
but

but likewise Pieces of Pumice-stones, and other large Stones.

Tuesday Night the Fury of the Mountain began to abate, so that on *Sunday* there was scarce any Flame seen to break out of the upper Mouth; and on *Monday* but little Smoak and Ashes. This Day it began to rain plentifully, which continued to *Tuesday*, and afterwards for many Days: A Circumstance which has constantly happen'd after the Eruptions of Times past.

The Damages done in the Neighbourhood by this Eruption of Fire and Ashes, are incredible. At *Ottajano*, situate between four and a half and five Miles from *Vesuvius*, the Ashes on the Ground were four Palms high. All the Trees were burnt, (or blasted) the People terribly affrighted, and many Houses crushed by the Weight of the Ashes and Stones that fell.

After the Description of this fiery Eruption, the Academy of Sciences [at *Naples*] thought proper to make an accurate Analysis of the Matter, and of the Salts, that were collected in great Plenty near the above-mentioned Fissures; and, towards the Discovery of the Truth, they effectually made the following Experiments:

EXPERIMENT I.

Some of the Stones of *Vesuvius* being pounded small, and the Loadstone applied to the Powder, some few Particles were attracted by it; and the same Powder, put into *Aqua-fortis*, caused a sensible Effervescence; whence it certainly contains no small Quantity of Iron: Which was also found upon Trial
in

in another Eruption by *Tomaso Cornelio*. But for the greater Elucidation of Truth, one of these Stones being applied to the Magnetic Needle, it turned to the Stone; and then carrying it round to the opposite End of the Needle, it immediately turned from it, in the same manner as if Iron was applied near the Compass.

EXPERIMENT II.

The Stones are not all of the same Density or Colour; but various, and of different Ponderosity. Some are composed of real Talc, others full of Marcasites: Some are almost all sulphureous, others nitrose; some of a grey Colour, others red.

EXPERIMENT III.

The Matter of the Current is spongy at Top, but very dense towards the Bottom; which is a Proof of the Fusibility thereof; whereby the heavier Bodies subsided, and the lighter remained at Top.

EXPERIMENT IV.

After growing hard, it retained part of the Heat above a Month, though unequally: For in the inward Parts, where the Air had not free Access, and the Matter was more compact, the Heat was much stronger than towards the Surface.

EXPERIMENT V.

Twenty Days after the Eruption, in divers Parts of the Mountain, from the Bottom to the Top, there were seen to arise many pernicious Damps,

[*Mofete*] especially from the Cavities, and the Fissures of former Torrents; as also on the Plain: But none were observed in the Matter of this last Eruption. They issued out of the Fissures under the Appearance of a cold Wind, and rose about three Palms high; then they moved along the Surface of the Ground, and, after a Progress of some Paces, disappeared. Animals, which happened to graze where these passed, were all killed thereby; and likewise a *Teresian* Frier, who inadvertently breathed the Vapour of one of these Damps.

EXPERIMENT VI.

Having placed the Barometer in the Vapour, it underwent no Change, but the Thermometer fell somewhat ~~more or less.~~ A lighted Torch, thrust into them at two Palms from the Ground, was soon extinguished by the Action of the Damp.

EXPERIMENT VII.

These Damps grew gradually weaker in their pernicious Effects for above three Months, even to the subsequent Autumn; as has been generally found in other former Eruptions, or when they happened to issue out of their Vents.

EXPERIMENT VIII.

Concerning the Salts which are generated in Abundance in *Vesuvius*, I have, by Order of the Academy, examined them by accurate Experiments. My Intention was to know, if besides Salt Ammoniac, there were also Sea-Salt, Vitriol, Nitre, or any
other

other Salt. I thought there was no better way of proceeding in this Inquiry, than by Crystallization; because it is universally allowed, that Salts in Crystallizing constantly retain one certain and determinate Figure; Sea-Salt concreting into Cubes, Vitriolic Salt into Rhomboidal Parallelepipeds, Alom into Octædrons, and Nitre into Rectangular Prisms on Hexagonal Bases. I imagined, that if the Salt of *Vesuvius* happened to contain any Particles of the Salts above-mentioned, it would discover them after Crystallization. This way of Reasoning was confirm'd by Experiment: For the *Vesuvian* Salt, in Crystallizing, left on the Sides of the Vessels small Parcels of crystallized Salts, which, observed through a Microscope, resembled a Tree with its Branches, on the Ends of which there appeared several Pyramids of an irregular Figure, but very sharp-pointed; and between the Branches there were interspersed in some Places a Group of Prisms, in others some small Cubes: Whence I inferred, that the aforesaid Salt was Ammoniacal, and indeed a genuine and efficacious Salt Ammoniac, with insensible Portions of Nitre and Sea-Salt. Which coincides with the Sentiments of the Royal Academy of *Paris* in 1705; with those of *Thomas Cornelius* in his *Progymnasma de Sensibus*; of *Dominicus Gulielmini* in his *Treatise de Salibus*; of *Dr. Boerhaave* in his *Chemistry*, and many other Writers.

EXPERIMENT IX.

In order to be convinced whether this Salt was really Ammoniacal, and of the Nature of neutral Salts, I mixed it with Spirit of Vitriol, and Spirit

of Salt, without producing the least Fermentation. I afterwards put some of it into Oil of Tartar *per Deliquium*, and could not perceive any Ebullition; wherefore it is to be ranked among the neutral Salts.

EXPERIMENT X.

Thrown upon red Coals, it did not crepitate like Sea-Salt, but it boiled and swelled, and after evaporating it dried up.

EXPERIMENT XI.

It is of a very pungent Taste, strongly pricking the Tongue, and of a bituminous Smell of Brimstone, which occasions a violent Head-ach by its volatile Texture.

~~EXPERIMENT~~ XII.

The Salts taken from different Stones are not all of the same Weight or Colour: For some are yellow and unctuous, as if rubbed all round with *Petroleum*: Others are very white, others blackish, and others of other Colours, according to the Stones they adhered to.

EXPERIMENT XIII.

I have likewise found by Experience, that the Salt Ammoniac of *Vesuvius* is much more efficacious than any other Salt known at this Day, in cooling Liquors. Upon dissolving some of it in Water, it makes the Water so cold, that the Sides of the Vessel which contains it, can hardly be touched without Uneasiness, through the excessive Cold.

EXPERIMENT XIV.

Monf. *Geoffroy*, a celebrated Member of the Academy of Sciences, looks on it as a fingular Power of common Salt Ammoniac, that being mixed with a certain Quantity of Water, it rendered the Water fo cold, that it made the Spirit of his Thermometer, eighteen Inches high, fall thirty-three Lines. But I have fhewn to feveral Perfons, that the *Vefuvian* Salt makes the Liquor of a Thermometer, like his, fall four Inches and an half; which is equal to fifty-four Lines. Wherefore the Efficacy of this Salt, in caufing the Fall of the Liquor, exceeds the Efficacy of common Salt Ammoniac by twenty-one Lines.

EXPERIMENT XV.

If round a Veffel full of Water cooled with Snow, there be put fome of the Salt of *Vefuvius*, the Water freezes and grows hard in a very little time.

EXPERIMENT XVI.

If you put a good Quantity of the Salt of *Vefuvius* into Snow fet round a [Glaſs] Veffel full of Water, and then ſtir the Veffel, the Water contained therein becomes unfit to drink; having acquired a very disagreeable acrid ſulphureous Taſte; a manifeſt Sign, that the Salt is divided into ſmall Particles, which paſſing through the inſenſible Pores of the Glaſs, enter into and mix with the Water.

EXPERIMENT XVII.

Of all kinds of Salts, this diſſolves in the greateſt Quantity in Water; and perhaps the greater or leſſer
Diſ

Diffolubility of a Salt in Water, will be [found] proportional to its greater or lesser Effect in cooling Water.

EXPERIMENT XVIII.

Being put into Brandy, or Oil, besides that very little of it is dissolved, it occasions no Descent of the Liquor in the Thermometer.

EXPERIMENT XIX.

Being mixed with Blood lately drawn from the Vein of a Man, but coagulated after settling, the Blood was thereby dissolved, and continued in that State for the Space of twenty-four Hours.

EXPERIMENT XX.

A Solution [of this Salt] being injected into the Vein of a Dog, first occasioned Tremors, then universal Convulsions, and lastly Death : And four Hours afterwards, having opened the Dog, the Blood, which should have been coagulated, was found fluid, both in the Trunks of the Veins, and at the Ends of the Arteries.

EXPERIMENT XXI.

It has all the Properties of Salt Ammoniac to that Degree, that upon substituting this *Vesuvian* Salt, instead of common Salt Ammoniac, the strongest sort of *Aqua Regia* may be had for dissolving Gold : Which Experiment was made with Success by Mons^r. *Lemery*, in the Academy of *France*.

EXPERIMENT XXII.

If a Lump of the Mineral Matter be reduced to a fine Powder, and attentively viewed through a Microscope, it appears very like the Sand of *Ischia*, and is very proper for Writing-Sand: Whence I conjecture, that that Sand is nothing else, but the [same] Matter for a long time comminuted by the Action of the Sea.

EXPERIMENT XXIII.

In some of the Stones there appear some few Veins of Gold, in others of Silver, but insensible; and in others, which are very heavy, there is some Antimony.

EXPERIMENT XXIV.

A great Dispute arose in the Academy on the Rise of the [*Mofete*] Damps; for what Reason these should be seen only in the old *Strata* of the mineral Substances, and not in the new, where by the Action of the Fire they ought to issue: Which *Phænomenon*, if I am not mistaken, may be accounted for in this manner: As the cooling of the burning Matter began at the Surface, we may think, that the more subtle heterogeneous Particles, upon the closing of the Pores at the Surface, remained in Quantities buried in the lower Parts of the Matter; which, in Process of Time, becoming acutangular and of deleterious Figures, yet cannot offend while imprisoned: But in new Eruptions, wherein the Shocks given to the Matter produce many Fissures, the Damps, meeting with less Resistance there, issue forth: As when the Air is a
long

long time pent up in some Hollow, upon giving it Vent, it generally comes out in a pernicious Vapour.

EXPERIMENT XXV.

It was observed, that the greatest Shocks happened to such things as stood exposed to the *Volcano*; but that those things which were not thus exposed to it, received but faint Shocks: A manifest Sign, that the Vibration of the Air had a great Share in the Shocks of the Earth: Which Circumstance is taken Notice of by *Borelli* with respect to Mount *Ætna*.

II. *An Abstract of a Letter from an English Gentleman at Naples to his Friend in London, containing an Account of the Eruption of Mount Vesuvius, May 18. and the following Days, 1737. N. S.*

SIR, Dated *Naples, Aug. 30. 1737. N. S.*

YOU have laid a very hard Task upon me, to send you an Account of the late Eruption. **

I was lodged for some time at *Chaja*, and afterwards at *Fontana Medina*, in the Face of this surprising Neighbour [Mount *Vesuvius*], which from thence doth not appear to be above two or three Miles distant.

It gave us Strangers constant Entertainment, by shewing us what it could do, as well as great Satisfaction to the People of *Naples*, who, whilst it continues burning more or less without ceasing, are under

no Apprehension (and I believe with good Reason) of an Earthquake: But we little thought of being invited to a Sight, *quod nunquam vidimus, & nunquam videbimus*; for by all the Accounts of the Living, there has not been any Eruption in their Remembrance near so violent, nor so furious; and Authors mention none to this Degree later than above One hundred Years ago. On *Friday, May 17. 1737. N. St.* I observed, as far as I could see round, that the Mountain was covered with white Ashes a great Way down, as it hath been with Snow in the Winter, which I could not find any body here or at *Barra* near *Portiche*, take any Notice of; though I should be apt to think for the future, that it might be a Fore-runner; for I had never seen any thing like it. *Pliny* observes in these Words, *Præcesserat per multos dies terræmotus minus formidolosus, qui Campania non solum castella, verum etiam oppida vexare solitus.* (*Plin. Lib. 6. Ep. 20.*). Other Authors say the contrary; though it may very likely be so, round and near the Foot of the Mountain; but this time I have not found any body sensible of it here; but it is certainly true, that our Windows and Doors shook all the time of the Violence of the Eruption, which I take to be from the very great Concussion of the Air upon the violent Explosions: A Door which had a Latch, to my great Surprise, opened often of itself. I cannot conceive a tremulous Motion of the Earth from the Mountain hither, unless it were thoroughly cavernous from thence, which the People here deny, and particularly the Author *Paragallo*.

On *Saturday Night, (May 18.)* this great *Phænomenon* began, and increased so much on *Sunday*,

that it brought half the People out to gaze at it, with great Variety (no doubt) of Passions and Ratiocinations. There were certainly, amongst some, great Apprehensions, by their being imployed in Processions, visiting their Churches, and exposing their Images of the Virgin *Mary*; but I looked upon them as very ungrateful to their great Patron [St. *Jannarius*], in having any Dread, when they even boast, that he has never failed delivering them from their greatest Distresses; but by the terrible Havock I have observed in their Country, as well as what has been made by this last Eruption, I find he hath always left them in the Lurch: However, as I had not lost a Grain of the Faith I ever had in that Saint,

I very boldly set out on *Monday* about two Hours before Sun-set. It was a melancholy Sight, to see the Road full of Numbers of poor Wretches, flying as from *Sodom*. I stopped on the Way, to observe the vast Clouds of Smoak, which was thrown up in a prodigious Column, to an Height not to be guessed at, which, by its gentle Waving and Undulation, was a most beautiful Sight; and when it had mounted so high, that it had lost the Force of the Protrusion, it was carried by the Wind a vast Way; but not too far for one to observe how its Rolls began to break, and, being dispersed and expanded, covered the Country underneath with Ashes and Darknes. There were many great Flashes of Lightning darted through this Pillar of Smoak, and frequent Discharges as of Cannon or Bombs, which were followed by falling Stars, such as we see from well-made Rockets. We turned off out of *Portiche*, to gain the North-

side

side of the Mountain, as far as we could, in Chaises, till we were forced to get upon Asses or Mules.

It was now growing dark, and the Fire began to be visible, which it was not in the Day-time, the Sun bearing no Rival. The prodigious *Bouillon* of Fire, and the extreme Force it was expelled with, as well as the vast Height it was carried up to, are not to be described or guessed at. If I should imagine an hundred *Stentors* or *Polyphemus's*, with as many of *Phalaris's* Bulls roaring all together, they could not bellow more terribly. But to have a truer Idea of this Scene, you must look into *Burnet's* most beautiful Painting of the general Conflagration. As we looked round this Northern Side, the whole Country appeared as if over-run by *Samson's* Foxes.

In a little time, by the Light of the Mountain, (though that was much obscured by the Clouds and Pillar of Smoak) and the Help of our Torches, we scrambled over very rough Roads, till we got within about a quarter of a Mile of the great *Lava* or Current: But then I ordered an Halt; for indeed the Scene on all Sides became so stupendous and terrible, that I thought I should make a very foolish Figure, if any Misfortune should happen to us.

We returned to *Portiche*, where we supped, and got home, much fatigued, by Two in the Morning. The Fury of this Eruption was at its Height this Night, as to burning; but the next Day (*Tuesday*) the *Columus* and *Bouillons* of Smoak were as great, and thrown out with as much Violence, which, as the Wind sat, carried its Destruction, not of the large massy metallic Bodies, but of infinite Quantities of Ashes and Cinders, all that Day, and Part of the Night.

Through the Columns of Smoak was a continued Lightning, the most beautiful Sight imaginable.

The following Day (*Wednesday*) we set out again to view the West-side of the Mountain at *Torre del Grejo*, Eight Miles from hence; where we heard, that the great *Lava* had stopped at the Church of the *Carmelites*, but not without carrying Part of it away: Yet the People were superstitious enough to think this Stop miraculous; though it made a great Breach on one Side, broke down and quite demolished their Sacrify, besides cracking the Roof. This *Lava* had from the Declivity taken the Water-course, which was the Preservation of the Country from being drowned (and the People had best look to themselves, unless they make another). This Hollow, which was for some Miles between Thirty and Forty Feet deep, and as many wide, was not only filled up, but the Matter rose as many Feet above the Surface of the Land about it: We walked to view it on one Side, but the Heat was so intense, and the sulphureous Stench so suffocating, that we were obliged to keep at a good Distance; and I was well informed by several, that it continued very hot a Month or five Weeks after; so long in cooling is that great Quantity of bituminous and metallic Matter, with which this *Vomes* is loaded.

As the Fury of the Expulsion and Explosion was much abated on *Tuesday* Morning, the Stop here was about Four o'Clock that Day in the Afternoon; which might be the more easily conceived, when no more of this vast metallic Matter was discharged, and the Motion of all the rest was relented, for want of more Protrusion, and the Bitumen growing a little cooler.

cooler. As this Stop was made at the Church, Part of the *Lava* took a Turn into the great large Road to *Salerno*, to a great Height; which Part is choaked up for ever, the Expence being immense to remove it. *N. B. Giulio Cesare Reputio*, one of the Authors who describes the Eruption in 1631. says, one of the maffy metallic Bodies was in his Time weighed, and the Weight amounted to Five hundred *Cantaras*, a *Cantara* being nearly Two hundred Weight. They have since made the Road passable, by laying Earth upon the *Lava*, and so have added to the Hills of their Country. There are some who pretend to say, that the Matter discharged this time in the different Currents or *Lava's* round about, would make a Mountain as big as their Sire. The *Carmelites* here soon fled, and were not come back ten Days afterwards, when we returned that Way, to visit the South-east Side, to view the great Devastation which was made about *Ottajano*, eighteen Miles from hence; for though the great Discharge of the metallic Body ceased on *Tuesday*, (*N. B.* they did not let their Patron budge till the next Morning) a vast Destruction of the Country followed for a long time after; for as the Force of the Explosion was very great, it continued to throw out vast Showers of Cinders and Ashes. The Lands indeed, where the *Lava's* fall, are annihilated to the Owners; but the other Materials destroy all the Fruit and Produce of the Earth where they fall, which doth not recover for a long time; and in this unhappy District, his Majesty hath, with great Goodness, taken off all Taxes for Ten Years.

As we turned on the Left from *Torre del Grejo* towards *Ottajano*, we passed all the Way through their *Masserias* [Farms]; and the Mountain, having the Weather-gage of us for three or four Miles, rained Ashes plentifully upon us, and we lost our Smell of every thing but Brimstone. All the Trees, Vines; and Hedges, bent under the Weight of these Ashes, several Arms, and even Bodies of Trees, were broken with the Weight; so that in some narrow Roads we had Difficulty to pass. Within a Mile or two of the Prince of *Ottajano's* Palace (a very honest worthy Gentleman, who has suffered a Loss of above 100,000 Ducats, or 50,000 *l.* some say more) one can scarce frame to one's self a Sight of greater Defoliation; Ten successive Northern Winters could not have left it in a worse Condition: Not a Leaf on a Tree, Vine, or Hedge, to be seen all the Way we went, and some Miles farther, as we were informed: Here, and at the Town, they had a new Earth, about two Feet deep, some said more, by the Account of the miserable Inhabitants, who were a dismal Spectacle, though they had recovered their Fright, and seemed to be got into a new Heaven. The Storm fell so thick and heavy for that time, that they almost all fled, and many Houses were beaten down. In one Convent, two or three Nuns were buried in the Ruins. At *Somma*, on the North-east Side, it has made great Havock; a Monastery of Nuns was destroyed. After a long Day's Work, we returned at Six o'Clock.

Thus, Sir, I have given you our Journal, and an Account of what I observed of this *Monstrum horrendum ingens!* I fear you expect some Reflections upon the

the *Phænomena*: A few Thoughts, though very common ones, I offer for your Correction.

The Earth of this Country is, no doubt, greatly compounded of Sulphur and Nitre, from whence Dr. *Burnet* hath fixed it for the Beginning of the general Conflagration; though he has, out of a particular Spite to the People of *Rome*, laid the Commencement of it there. The great Quantities of Sulphur and Nitre are, to be sure, the Operators of these great Explosions, Lightnings, Bombs, Bellowings, and Expulsions of all this Matter; and Nature can certainly make much stronger and more elastic Gunpowder, than Mankind; else those great massy Bodies of Metals could not be thrown up with that vast Force, to that great Height. The Bodies are compounded of various Metals, and, as it were, incorporated with the Bitumen: They pretend to find some Silver, but I question whether the Gains will pay the Costs. They have spoken of the *Lava's*, as if their Motion was quick; but I observed otherwise, that it is slow, and the Progression rather like a vermicular one: And besides trusting to my Sight, I am rather apt to think it must be so, because, though in a great Declivity, these great Masses must be much retarded in their Motion, by their large unequal Points or Angles; besides, the Glewyness of the Bitumen as it cooled, would very much impede a quick Motion; which Bitumen is that Matter that flames, smokes, and is so very suffocating.

By some of the Antients, these burning Mountains have been looked upon as Divinities, and that they lived there: To confirm which, there was a Marble found at *Capua* (as *Paragallo* affirms) with this Inscription,

scription, *Jovi Vesuvio sacrum D. D.* The Greeks made use of them in their Mythology, by clapping the Rebel Giants under them.

I must not conclude without saying something of the *Mofete*, upon which much hath been written, particularly by *Leonardo de Capua*; but all might be reduced into a narrow Compass. I mention it now, because it hath given great Terror to the Neighbourhood of this Mountain; Four or Five Persons near *Torre del Grejo*, *Portiche*, and some other Place, having been killed by going into their Caves or Cellars: And it is particularly remarked to have been thus destructive all round the Hill, after the great Eruptions; upon which the great Agitation and Rarefaction of this inflammable Earth, composed of such active Particles, even *Sal Ammoniac*, must send out vast and strong *Effluvia*, (or what in such close Places may properly be termed Exsudations) pernicious, no doubt, when confined under Ground, and hindered from expanding and mixing with fresh Air: And, no doubt, all round the Mountain they abound; but the open Air is a Specific against their ill Effects; as we see it is an immediate Cure to the poor Dog at the *Grotto del Cane*, and not any particular Quality of the neighbouring Lake, which Throwing him into, I should rather think, would kill him, till he had recovered his Respiration and Spirits. *Virgil, Æn.* VII. 84. mentions these Damps:

——— *Nemorum quæ maxima sacro*

Fonte sonat, siveamque exhalat opaca mephitim.

And to these Stenches *Persius*, Satire III. l. 99. resembles the Scent of a stinking Breath:

Gutturæ sulphureas lente exhalante mephites.

The

The following Authors have given very ample Accounts of the Eruption of Mount *Vesuvius*, on Dec. 16. 1631.

Giulio Cesare Braccini; Dell' Incendio fattosi nel *Vesuvio*, a 16 Dec. 1631. *Neapoli*, 1632. 4^{to}.

Don Juan de Quinones; El Monte *Vesuvio*, *Madrid*. 1632. 4^{to}.

Julius Cæsar Recupitus; de Incendio *Vesuviano* Nuncius, *Neapol*. 1632-3. 8^{vo}.

Joh. Bapt. Musculus; de Incendio *Vesuvii*. *Neapol*. 1633. 4^{to}.

Gaspar Paragallo; Ragionamento de' *Tremuoti*. *Napoli*, 1689. 4^{to}.

III. *De Atmosphæra Lunari, Dissertatio Astronomica.* Auctore D^{no} Johanne Paulo Grandjean de Fouchy, in *suprema Galliæ Rationum Curia Senatore, & Reg. Scient. Acad. Paris. Socio.*

CELEBERRIMA est apud astronomiæ physicæ cultores de atmosphære lunaris existentia quæstio. Multi, iique præstantissimi viri, ipsam diversis rationibus physicis solvendam, sed vanis hucusque conatibus, susceperunt. Tot igitur & tantorum artificum irritis laboribus edoctus, aliam mihi viam tenendam statui; ipsiusque atmosphære lunaris existentiam ex meris observationibus inquirendam judicavi, non quidem ex ipsius atmosphære corporis directo intuitu, quippe quod oculorum aciem facillime effugere posset, sed ex phænomenis ipsius existentiam necessario comitantibus, puta refractione radiorum ipsam, luna pleno

orbe fulgente, & in eclipsibus solis & fixarum a luna, pertranseuntium; idque eo libentius, quod ista radiorum refractione minime ab atmospheræ altitudine pendeat, quin e contra ipsi quodammodo reciprocetur; eadem enim atmospheræ virtute refringente supposita, eo major erit refractione, quo minor atmospheræ altitudo, radio luminis in superficiem ipsius obliquius incidente.

Atmospheræ nomine intelligitur quædam materiæ diaphanæ congeries planetam involvens, quæ radios luminis ipsam pertranseuntis a recta linea deflectere potest; sive hæc materia in aëre nostro simili, sive separatim ab ipso existat, quicquid sit, hic de sola materia refringente agitur, idque tantum in hujus operis decursu probandum suscipio, nullam circa lunam dari materiem, quæ radios luminis a recto tramite sensibilibus deflectere valeat. Hoc unum lectorem admonitum volo, me hic atmospheram ut fluidum homogeneous concipere superficie spherica obductum, ejusdemque ubique densitatis, quæ decreverint densitatum in reali atmosphaera existentium summæ æqualis sit, ommissa expresse partium ejus densitatis differentia, quæ nullatenus nostras demonstrationes turbare potest. His itaque præmissis, ad rem ipsam properandum est: Et primo, quid variationis in diametris lunaribus ipsius, si existat, atmosphaera afferre possit, discutiendum.

TAB. I. FIG. I. Si luna atmosphaera cingitur, major observari debet ipsius diameter, quam in planeta nudo observaretur: ut autem ejus incrementi quantitas innotescat, sit *AIB* ipsius lunæ corpus, *GEF* ipsius atmosphaera, erit angulus *AHL* ipsissima lunæ diameter; & angulus *EHL* axe *LH*, & radio *AEH*, in *E* refracto comprehensus, erit diameter lunæ observata.

fervata. Angulus igitur EHA erit incrementum diametri lunæ ob ipsius atmosphæram: Sed angulus EHA opponitur lateri EA trianguli EHA ; & angulus AEH supplementum ad 180° refractionis horizontalis in atmosphæra lunari opponitur lateri AH distantiae lunæ a terra. Porro latus EA medietas est chordæ atmosphærae lunaris ipsius lunæ corpus in A tangentis. Sinus ergo incrementi EAH diametri lunæ ob ipsius atmosphæram erit ad sinum supplementi refractionis horizontalis AEH , ut medietas AE chordæ atmosphærae corpus Lunæ tangentis ad distantiam AH lunæ a terra.

Hinc sequitur plane insensibile evadere illud diametri lunaris incrementum: Si enim ad $2''\frac{1}{2}$ assurgeret, supposita refractione horizontali $5'$, id est, triginta saltem vicibus majori, quam supponi potest, ut ex infra dicendis patebit; semichorda EA 276 leucas Gallicas æquaret, atmosphæraeque terrestris chordam similem longe superaret. Luna igitur atmosphæra cingatur, necne, eadem semper observabitur ejus diameter; nulloque modo diametri lunaris observatio solvendæ quæstioni par esse potest.

FIG. 2. Majorem decidendi dubii ansam præbent eclipses solis a luna: Radii enim extremi conum umbræ lunaris terminantes, utpote qui corpus lunæ stringunt, & ejus atmosphæram pertranscunt, necessario versus conî axem inflectentur; ideoque brevior & obtusior conus evadet: ut autem illius variationis quantitas innotescat, notandum est radium FA , seu ipsi parallelum EG , qui, si nulla existeret atmosphæra, umbræ lunaris FAC terminus esset, in ipso atmosphærae ingressu G , & in egressu H , versus axem CA , refringi: unde semiangulus conî umbræ lunaris

quantitate duplæ refractionis horizontalis in atmosphæra lunari augebitur.

Hinc sequitur, posita atmosphæra lunari, totalem solis eclipsin serius incipere, & citius absolvi, quam illa sublata; quin etiam in certis casibus nullam fore eclipsin totalem; quam tamen diametri lunares & solares in eodem anomalîæ gradu observatæ poscerent: in his enim casibus conus umbræ lunaris ob atmosphæram contrahitur, & ita contrahi posset, ut ne quidem discum telluris mucrone tangeret.

FIG. 3. Eodem plane modo minuerentur eclipsium partialium duratio & quantitas: eclipsis enim partialis initium observatur, cum penumbræ conus *GDI* habitationem observatoris supergreditur: supposita autem duplici in lunæ atmosphæra refractione *FCE*, *EVH*, semiangulus conus penumbræ minuitur, semidiameterque basis *GI* in *IH* contrahitur: ut igitur in loco dato initium eclipseos observetur, centro *I* basis penumbræ spatium æquale *GH* percurrendum erit: idem de emersione dicendum. Partialis ergo eclipsis serius incipiet, & citius absolvetur, supposita atmosphæra lunari, quam luna nuda; quin etiam & minor observabitur: habitatio enim *T*, in penumbram quantitate *TN* immersa, posita atmosphæra lunari, ipsam distantia tantum *TK* ingreditur. Fieri etiam poterit, ut nulla eo loci observetur eclipsis, ubi nulla supposita circa lunam atmosphæra observaretur: disco enim penumbræ imminuto, locus *R*, qui luna nuda in eam immergeretur, quantitate *RN* immunis ab ipsa pertransibit. Qui autem in spatio *TH* radium inter directum *XT* atmosphæram radentem, & radium refractum *EH* penumbram terminantem, comprehenso
degens

degens solem ab ipso quidem lunæ corpore expertem, sed tamen ab ejus atmosphæra obscuratum, videbunt; ideoque penumbra quædam pallida, quæ quidem ex prædemonstratis, ubi de altitudine chordæ atmosphære lunaris, & diametri ejus incremento, tertiam aut quartam ad minimum diametri lunaris partem lata observabitur, discum lunæ prægredi & subsequi debet: quin etiam hæc obscuratio absque omni eclipsi observari poterit, quotiescumque circa terminos eclipticos luminarium synodus celebrabitur.

Hæc quidem præcipua phænomena in solaribus eclipsibus observari debent, si circa lunam existat atmosphæra: quid autem revera observetur, nunc videndum est.

Primo, Cum axis umbræ lunaris ad 55 semidiametros terrestres, cum maximus, & $52\frac{1}{2}$, cum minimus est, extendatur, & præterea minima lunæ a terra distantia sit 54 semidiametros terrestres, si atmosphæra lunaris refractionis horizontalis $8''$ capax esset, semiangulus conii umbrosi quantitate dupla, id est, $16''$, ex prædemonstratis augebitur; ideoque $16' 41''$, cum apertissimus, & $16' 5''$, cum angustissimus, æquabit. Porro minimo semiangulo conii supposito æquali $16' 5''$; minor erit ejus axis minima lunæ a terra distantia 54 semidiametrorum terrestrium, proindeque mucro umbræ lunaris nunquam ad terram usque pertinet. Si igitur circa lunam existat atmosphæra, in qua refractionis horizontalis sit $8''$, nulla dabitur solis eclipsis totalis in terra. Nulla ergo existit circa lunam atmosphæra; aut, si existat, refractionem horizontalem $8''$ minorem producit.

Quin & solares defectus totales cum duratione totalis obscurationis observantur. In eclipsi, v. g. anni

1724. duratio obscurationis totalis ad $2' 16''$ assurgebat. Luna tunc temporis motu horario $1' 15''$ percurrerebat, umbraque ejus sibi semper parallela in disco terræ gradibus spatium 54 vicibus majus, id est, æquale $1^{\circ} 7' 30''$, perambulabat: unde, si auferatur motus diurnus habitationis æqualis $20'$, quippe qui durationem eclipseos prolongare potest, diameter umbræ habebitur æqualis $47' 30''$, seu 45173 hexapedis, seu tandem 22 leucis Parisiensibus. Unde instituto calculo eruitur axis conii umbræ lunaris uno saltem terræ diametro major distantia lunæ a terra, quæ tunc minima erat, luna circa perigæum versante. Porro ex datis luminarium diametris in eodem anomalix gradu observatis axis conii umbræ lunaris elicitur 55 semidiаметros, ad minimum, æquale: unde sequitur maculam umbræ lunaris in disco terræ, & axem conii, eisdem præcise reperiri, quos distantix lunæ & luminarium diametri observatæ postulare videntur. Nulla igitur circa lunam existit atmosphæra, aut nullam, si existat, refractionem sensibilem producere valet. Sed ut nullus dubitationi locus relinquatur, eorum reddenda est ratio phænomenon, quæ in eclipsibus solaribus observata atmosphæræ lunari excogitandæ locum dedere.

Primo quidem, exigua illa, quæ in defectibus totalibus observatur, lucula nullam in fluido lunam ambiente refractionem arguit; experimentis enim D. *Maraldi* a meipso summa cura, & eodem successu, repetitis, constat corporum nulla certe atmosphæra vestitorum, si soli exponantur, umbram circa conii axem clarescere; idque eo magis, quo longius ab ipso corpore receditur, Porro habitatio observatoris in defectu totali circa axem conii umbræ lunaris, & in
ejus

ejus mucronis vicinia, versatur. Mirum igitur esse non debet medium umbræ luce quadam maligna suffundi, quæ aliunde augeri potest radiis ab aëre illuminato umbram ambiente versus umbræ medium reflexis.

Secundo, annulus lucidus lunam in defectibus totalibus ambiens atmosphæræ lunaris existentiam nullo modo probat, cum cuivis solem pila lignea, vel alicujus materiæ opacæ sibi occultanti appareat. Unde atmosphæræ solari, non lunari, tribuendus est; ut abunde probavit Cl. D. *De Mairan* in tract. de Aurora Boreali, Sect. I. Cap. I. pag. 14.

Tertio, imminutio diametri lunaris, quæ in eclipsibus solaribus 30'' circiter minor observatur quam luna in eodem anomalix gradu pleno orbe fulgenti; hæc, inquam, imminutio atmosphæram lunarem minime probat, etiamsi observentur in disci lunæ circumferentia quædam montium inæqualitates, quæ in luna plena penitus evanescunt: objecta enim lucida fibras oculi tam valide concutiunt, ut motus ipsarum fibris vicinis communicetur, & ita corporis lucidi imago ultra debitam quantitatem augetur, quod experientia pervulgata notum fiet: si enim palus seu fustis lunam inter & oculum subjiciatur, diameter pali e regione lunæ imminuta videbitur; quod si tunc temporis nubes aliqua planetam subeat, minor videtur pali deminutio; nulla est, si planetam nubes ab oculis surripiat; ac tandem pro varia lucis lunaris intensitate varia observatur.

Quod ad montium inæqualitates attinet, eadem ratione in luna potius sitiente, quam in luna plena, observari debent: montes enim lunares per se obscuri, in solis fulgentissimo orbe conspecti, longe minus

minus oculorum aciem fugiunt, quam ubi luna plena clarescentes vicino lunæ splendore extinguuntur; cum præsertim ea sit lucis lunaris intensitas, ut in ejus vicinia ægre admodum stella tertiæ magnitudinis discerni possit. Sed ut nodus hac in re penitus præscindatur, si lunæ soli oppositæ limbus ejus atmosphæræ non ipsissimi corporis planetæ terminus esset, telescopiis longioribus, arctioribusque aperturis objectivis, montes in lunari peripheria numquam observarentur: porro tubo optico 36 ped. Paris. & apertura objectiva unius pollicis, multoties plurimas montium inæqualitates in lunæ plenæ disco observavi; unde sequitur lunæ plenæ discum ejus corporis, non atmosphæræ peripheria terminari.

Quarto, nunc demum de mira illa Anni 1715 observatione fulgurum lunarium *Londini* facta * a Dno. *Delourville*, præsentibus multis REGIÆ SOCIETATIS astronomis, paucis est differendum; paucis quidem; quid enim de re ante & post hanc eclipsin inobservata dicendum? Si tamen aliquid in medium de tam insolito phænomeno proferre liceat, supponemus limbum lunæ visibilem ex insitis montium cacuminibus componi; quæ quidem in eclipsi totali solem observatori eodem modo occultant, quo sylvarum majorum arbores visui officiant. Unde si in lunæ superficie quædam montium series liberum in rectam lineam transitum radiis solaribus præbuerint, fulgurum quorundam speciem mentiri debuerunt, eodem modo ac si in camera obscurata radius solis ope speculi subito

* Observatio hæcce facta fuit revera a Cl. D. *Edmundo Halleio*, præsentem quidem D. *Delourville*, uti videre est in *Transact.* N^o 343, p. 249. C. M.

intromittatur, & subtrahatur objectorum externorum pictura in foco lentis exarata, tractibus luminis fulguri simillimis illustrabitur: quod quidem eo libentius admittendum censeo, quod ista subitanea fulgura in limbi lunæ vicinia semper observata fuerint; ut ex ipso hujus eclipscos schemate * ab illustrissima D. *Sara Sloane* exarato patet.

Quod ad pallidam illam fasciam limbum lunæ in hac eclipsi comitantem, cum in eclipsibus solaribus hucusque observatis nil simile nec mihi nec cuiquam astronomo apparuerit; quod tamen in hypothese atmosphæræ lunaris semper & ubique observari debet; nullam ejus mentionem hic faciemus.

Ex his omnibus manifestum est nihil in eclipsibus solis observari atmosphæræ lunari consonum. Nunc de fixarum & planetarum eclipsibus a luna differendum.

FIG. 4. Si luna atmosphæra cingitur, planetæ & stellæ fixæ serius pone lunam occultari, & citius ab ejus disco egredi, observatori in terræ superficie constituto videbuntur, quam luna absque atmosphæra supposita; quin & in quibusdam locis, in quibus videri debuisset planetæ vel fixæ a luna eclipsi, nulla observabitur: quod ut manifestum fiat, sit corpus lunæ *ABC*, & stella in *S* distantia quasi infinita posita; radii paralleli *LV*, *MX*, lunare corpus undique contingentes, superficiem cylindricam constituunt, cujus quidem cylindri basis *VZX* in disco telluris cunctas habitationes, in quibus stella seu planeta a luna tegitur, suo ambitu comprehendit. Observator itaque in *V* initium eclipscos, & finem in *X*, conspiciet, durationem-

* In Museo celeberrimi patris ejus Cl. Dⁿ. *Hans Sloane*, Bart. R. S. Pr.

quæ metetur temporis, per quod luna diametraliter transit, seu potius spatium huic æquale percurrere poterit. Si autem lunæ atmosphæra supponatur radius WW , axi cylindri parallelus non remanebit, & cylindrus ipse conus evadet, cujus sectio TTU habitationem, in quibus debetur eclipsis, designabit. Porro angustata basi TTU , punctum T serius habitationem supergreditur, quam punctum V ; limbsque U citius ipsam deferet quam X : serius ergo incipiet stellæ vel planetæ a luna eclipsis, & citius absolvetur, atmosphæra circa lunam supposita, quam luna nuda: quin & nulla observabitur eclipsis eo loci, ubi absque atmosphæra observari debuisset; locus enim C , circumferentia VZX prioris cylindri involutus, a sectione conici TTU immunis erit. Porro supposita refractione horizontali in lunæ atmosphæra æquali $8''$, VY , 1384 hexapedas, id est, leucæ Parisiensis dodrantem æquabit: unde sequitur nullam in locis calculo indicatis eclipsin observari debuisse, quotiescumque in cylindricam aream non magis leucæ dodrante immerguntur.

Aliud etiam phænomenon ex atmosphære lunaris suppositione oritur: in cylindri parte TR stella quidem semper videbitur, sed interposita atmosphæra lunari: ideoque motum & colorem a genuino diversum induet; idque in omnibus omnino eclipsibus, siue stella sit maxima siue minima.

Porro, eclipsium fixarum & planetarum a luna duratio nullo modo imminuta videtur, sed semper diametro lunæ, & motui ejus, præcise consona observatur. Quod ad illas attinet observationes, in quibus stella post contactum, in disco lunæ paululum progredi ante occultationem videtur, ipsarum causam in
auctam

auctam lunæ & stellæ diametrum penitus refundemus: si enim hujus apparentiæ causa esset atmosphæra lunaris, semper in omnibus stellis, & cum quibuslibet objectivorum aperturis, eadem observaretur. Porro nullam hæcenus stellam in disco lunæ progredientem observavi, nisi primæ, aut ad minimum secundæ magnitudinis, idque dimidia ad maximum sui parte; & diameter vera fixarum, ut cuilibet observanti satis constat, insensibilis evadit, nec nisi a radiis spuris augetur: unde radii adventitii tam stellæ quam lunæ in fundo oculi miscentur ante veram corporum stellæ & lunæ copulam: aliunde, si limbus lunæ visibilis atmosphære non ipsius corporis terminus esset, majoribus rubis, & angustioribus aperturis objectivis, nulli in peripheria montes observarentur; qui tamen, ut supra dictum est, satis clare conspiciuntur.

Ex his igitur omnibus manifestum erit lunam nulla atmosphæra refringente vestiri, cujus refractionis observationi pateat: fieri enim posset, ut circa lunam existeret atmosphæra, in qua refractionis horizontalis ad 1" vel 2" assurgeret: huic enim opinioni suffragari videntur majores in luna maculæ, quæ nullo modo sylvæ dici possunt, ut Clar. *Hartsoëker* & aliquibus aliis visum fuerat. Umbræ enim marginum semper limbo lunæ claro viciniore observantur; unde recte concluditur eas cavitates esse non sylvas, quæ ex altero latere umbram projicerent. Porro supponi potest in ipsis fluidum quoddam, quo quidem casu halitus ex ipsis a sole extolli valde physicæ consonum esset; quorum congeries speciem quamdam atmosphære circa lunam mentiretur; quæ quidem atmosphæra nec densa admodum, quippe quæ ex Cl. *Newtoni* demonstratis vix, cæteris paribus, tertiam halituum

terrestrium densitatis partem adæquaret, nec sibi ipsi diversis temporibus similis observaretur, vaporibus istis omni alio adminiculo destitutis.

Multa sunt & alia ratiocinia physica, quibus nostra de atmosphæra lunari opinio fulciri posset : sed astronomice tantum, non physice, rem discutiendam suscepimus. Lectorem fatis in hujus operis decursu distinuissè mihi visus sum : huic itaque finem impono, illustrissimæ SOCIETATIS in re tam ancipiti judicium pro ipsissima rei veritate libentissime amplexurus.

IV. *A Narrative of an extraordinary Sinking down and Sliding away of some Ground at Pardines near Auvergne, sent from M. T— to a Relation in England, translated from the French, and communicated to the ROYAL SOCIETY by Phil. Henry Zollman, Esq; F. R. S.*

THE Parish of *Pardines*, in the District of *Issoire* (in *Auvergne*) is situate about a League from the Town of *Issoire* on the Road to *Clermont*, almost on the Top of a pretty steep Hill.

This Parish consists of two Villages or Hamlets distant from each other about 200 Paces ; the one, which is called *Le Fort*, in which is the Parish Church, and Part of the Houses of the Inhabitants, stands upon a Rock ; there appear the Remains of an antient Fortification, with which some Houses were surrounded in the time of the Wars.

The

The other Village, which is properly called *Pardines*, was composed of the greater Part of the Houses of the Inhabitants to the Number of 46 Buildings ; the Ground whereon this Village was built, as well as that of the whole Hill, is a good and light Earth, mixed with a little white Clay : There are also found in it some Stones and Rocks of a middling Size. This Land was very well cultivated, and very fruitful, consisting of Fields sowed with Corn, of Orchards, and for the greater Part of Vineyards ; the whole Ground was overspread with Fruit-trees, particularly Walnut-trees.

This Earth used to dry soon and chap from the Heat ; they even observed in it long since Clefs of a considerable Depth, which sometimes growing wider and wider, formed several Gullies.

On the 23d of *June* 1733. about Nine in the Evening, the Inhabitants of the Village of *Pardines* saw the Walls of their Houses shake sensibly ; whereupon they all retired out of them, and saw that the Hill visibly melted away, as it were, the greater Part of the Land sliding along towards the Vale ; others subsided sensibly ; in some Places the Earth, opening itself, formed new Gulls, and those that were observed there before, grew much wider ; sometimes the Ground which slid along in great Pieces, stopt and tumbled one Piece over the other ; and the Rocks, which broke loose from that rolling Earth, precipitated themselves into the Valley, which at present is quite filled up with them, as well as with the Earth which rolled down, whereby the Road from *Iffoire* to *Clermont* is become impassable.

All this was done, not with any impetuous Motion, but very gently, and even sometimes almost imperceptibly; a sensible Motion was observed during the Space of three or four Days at different times; there was even a House which did not fall till the 10th of the present Month of *July*. During all that Time no Noise was heard, any otherwise than what proceeded from the Rocks falling into the Valley, and from some large Clods of Earth, which loosening themselves from the steeper Parts, fell down with Precipitation.

By this Rolling were carried away 26 Buildings, large or small, some of which subsided with the Ground, and, being shaken at their Foundations, tumbled on a Heap; the Remains of some others appear, as yet, on those Pieces of Ground that rolled down into the Valley.

It is computed, that the Lands which slid away, or were lost by being buried under the Rubbish of the others, amount to the Number of 466 *Oeuvres* of Vineyards, 40 *Septerees* of arable Land, and 56 *Oeuvres* of Grass-fields, which all together may make up 150 Acres of *Paris* Measure. It is observable, that in this Number were comprised several Orchards, besides that the whole Ground was covered with Trees, either Walnut-trees on the Hill, or Willows and Poplars in the Valley, of which they reckon 4000 in all.

If one may conjecture what was the Cause of so dismal an Accident, it seems it proceeded from the Situation of the Ground, and the Nature of the Soil. The first Surface of the Hill about four or five Foot deep, was a pretty light Earth, easily dried by the

the Heat of the Sun; under this first Layer there was a *Stratum* of fat Clay, which at present lies open in several Places, and which is very moist, so that one even sees the Water bubbling out of it in some Places.

The great Rains that fell in the Beginning of the Spring, soaked through and diluted this *Stratum* of Clay, which retained and gathered all the Waters of the Hill running between the two Layers; the Heat of the Summer ensued, which dried up the upper Surface, and formed it into a sort of solid Crust, which Crust resting itself upon a fat and moist Clay, and by its steep Situation being inclined to slide towards the Valley, the whole Surface of it loosened itself by great Pieces, and breaking in several Places, slid along towards the Place whither its Declivity would naturally carry it. There are some Parts which moved almost insensibly, and only sunk or subsided, either because the Rolling of the neighbouring Soils made room, that what was under this Surface might slide off, or perhaps because the Parts under this Surface had been hollowed a long while since, by the Waters which passed between this Surface and the *Stratum* of fat Clay. Other Parts, which were much more in Number, rolled all together towards the Valley, and one sees yet whole Pieces of Vineyards, with the Props remaining upright; which may easily be conceived: There are again other Parts, which in tumbling were overturned in different manners.

I am to add here, that this Accident is not without Example in the Province of *Auvergne*; we have not indeed seen so considerable a one till now, yet
it

it has often happened, that Pieces of Earth of a Quarter or Half an Acre, have separated themselves all in one Piece, from the Top of a Hill, and slid down visibly on the Lands lying below.

How considerable soever this Accident may be in regard to the poor People who suffered by it, yet it was to be wished it was the only one that has befallen this Province. The Overflowings of the River *Allier*, and of the Rivers and Brooks that run into it, and the Hail that fell almost continually since, have intirely ruined above One hundred Parishes, in which they will have no Harvest this Year as for Corn and Hemp, nor any Vintage at all.

V. *A Dissertation on the Worms which destroy the Piles on the Coasts of Holland and Zealand, by Job Baster, M. D. F. R. S. communicated by the President of the ROYAL SOCIETY. Translated * from the Latin by T. S. M. D. F. R. S.*

SECTION I.

IN the Year 1730. the Persons appointed to take care of the Dikes on our Coasts, observed that the Piles made of the hardest Oak, defending the

* This is here inserted in *English*, because a very ample Treatise hath been published in *Latin* on the same Subject, intituled, *Godofredi Sellii, J. U. D. R. S. Lond. S. Hist. Nat. Teredinis seu Xylophagi marini. Tubulo-conchoïdis, Traj. ad Rhen. 1733. 4to.*

Coasts of the *Netherlands* against the Sea, were eat through in a few Months, so as to be broken by the least external Force. Surprised at this uncommon and dangerous *Phænomenon*, they inquired into its Cause, and saw that a sort of Worms, before that time very scarce, but now increased to an incredible Number, had in so short a time eat into those Piles between the highest and lowest Water-marks, and threatened very great Damage to the Inhabitants of these Countries.

The superstitious Populace immediately persuaded themselves, that this new Genus of Animals was created by the divine Wrath for punishing the Sins of Mankind: But prying Experience has taught, that those Worms, like other Insects, were created in the Beginning; but now multiplied to an incredible degree from some unknown Cause.

S E C T. II.

If a Pile of the hardest Oak has stood six Months on the Shore, and be taken out in Summer or Autumn, there appears Mud and Filth sticking to its outward Surface; which being scraped off with a Knife, discovers a vast Number of Holes, scarcely as large as Pins Heads.

S E C T. III.

If you view this Mud (SECT. II.) through a Microscope, you will see,

1. A Number of whitish Points, not bigger than Grains of Sand.
2. Some very small Worms.

The whitish Points seem to be the Eggs of this Insect, and the Worms to be such as are already hatched from them; and these Worms gradually perforating the outward Surface of the Wood, rendered soft by lying in the Water, made the aforesaid Holes, (SECT. II.) and through them worked their way into the Substance of the Wood.

SECT. IV.

A small Style of Whalebone or Lead, thrust into these small Holes, runs strait into them for three or four Lines, so that its outer End always makes a right Angle with the Pile: But afterwards, if the Style be gently pushed forward, it does not continue in the strait Line, but runs either way, generally upward.

SECT. V.

But if one of these Piles (SECT. II.) be split lengthwise with a Hatchet or Wedge, it is found full of Passages, or hollow cylindrical Ducts, each of which contains a Worm, surrounded with a thin testaceous Substance, exactly filling the Duct, and forming its *Involucrum* or Sheath, in which Sheath it can move with Freedom. See SECT. XIX.

These Ducts, (SECT. IV.) beginning at the outward Surface by a narrow Hole, grow gradually wider, and run either strait, oblique, upward or downward. But what is most surprising is, that these Ducts never run into one another, nor communicate; but each of them continues separate for every single Worm. Over the Worm's Head there are found two or three Drops of a salt Liquor, thicker than Water, but
not

not the least Appearance of the Dust of the corroded Wood.

S E C T. VI.

Whence it appears, that all the Wood, which had before filled up the Place of the Dust, in which the Worm with its Covering is now found, was eaten and consumed by the Worm: And as it seems quite incredible, that an Animal, which appears soft, and almost as fluid as the White of an Egg, should be able to eat through such hard Wood; I offer the Description of this *Xylophagous Worm* to the ROYAL SOCIETY, in order to give them some Knowledge of this Water-Insect, which has done so many Millions Damage to these Countries.

S E C T. VII.

They are found of various Sizes and Thickness. There are some of the younger ones not above an Inch or two in Length; some of a middle Size, such as we have represented in our first and second Figures; see TAB. II. and some thirteen or fourteen Inches long.

S E C T. VIII.

But in order to a more accurate Description, we will divide the Animal into Head, Body and Tail.

The Head is of a most wonderful Structure, being covered with two hard . . . (I know not which to call them, Shells or *Hemicrania*) of a Substance neither testaceous nor osseous, securing their softer Contents: And being viewed through a Microscope, they appear as in Figure 3. as well as I could have them drawn.

S E C T. IX.

These *Hemicrania* are two white Bodies, much harder than the Substance which forms the testaceous Covering; the inner Surface hollow and smooth; the outer, convex and rough, with three Fibres running different ways; and both together perfectly represent a double Bit, of that kind of Borer, we call an Augar.

S E C T. X.

The upper Part of the external convex Surface (Fig. 3. *A.*) has a very sharp Edge, in which the first Series of Fibres begins from one Point; which Fibres gradually dilating, and running lengthwise, end about the middle Part of it; and this middle Part makes a right Angle with the upper Part. In this Part the Fibres being elevated, run cross-wise (Fig. 3. *B.*). The lower Part is thicker than the upper, but softer and less compact. In this Part the Fibres are raised up and rough, first curve, then strait, and, like the others, run length-wise to the lower Edge of this Part, which is strongly fastened to the Head by various Ligaments (Fig. 3. *C, D.*).

S E C T. XI.

The concave or inner Part of these *Hemicrania*, (S E C T. IX.) which contains the softer Parts of the Head, is very smooth; but almost in the Middle has a very small and tender Eminence or Process, (in Shape much like Dr. *Rau's* Process in the Organ of Hearing) fixed at one End, and loose at the other, running almost
the

the whole Width and doubtless destin'd for supporting some of the inward Parts of the Head (*See Fig. 4. A.*).

S E C T. XII.

These two *Hemicrania*, connected together by strong Ligaments, and as it were by a small Hinge, (by means whereof they can dilate without separating) besides their defending the soft Head from external Injuries, are the Instruments wherewith the Animal gets its Food. For whatever way it turns its Head, the raised and rough Fibres, running either length-wise or cross-wise, always rub off some of the Wood.

S E C T. XIII.

These *Hemicrania* carefully removed, the contained Parts (*Fig. 6*) are laid open to View; but they are so soft, and of so wonderful a Structure, that the Eye, though armed with a Microscope, can neither discern their true Make or Use. First, indeed, there appears a Membrane enveloping the whole Head; in the middle and anterior Part, which is not covered by the said *Hemicrania*, it appears as if raised by a *Tubercle*, (*Fig. 6. c.*) and in that Place it is of a red Colour; but the lower ligamentous Edge firmly adheres both to the small Process (*SECT. XI.*) and to the lower Edge of the *Hemicranium*.

S E C T. XIV.

This Membrane carefully separated and removed, (*Fig. 7. A. A.*) in the middle of the subjacent Pulp you will find a small Pear-like Body, perfectly pellucid, somewhat protuberant above the other Parts,
which

which made the *Tubercle* in the Membrane (SECT. XII.). It is much harder than the other contained Parts of the Head and Body; so that it will bear cutting with the Scalpel. It is of a red Colour, as perfectly pellucid as a Drop of Water; of the Shape of a Pear, from a larger Basis terminating in a Point. I cannot better resemble it to any thing than to the Crystalline Lens of the Eye: Yet in Spirit of Wine it preserved its Transparency, but its Bulk was diminished (Fig. 7. B.).

I cannot guess its Use: It does not seem to me, as it does to some, to be the Organ of Sight; for the Worm seems to have no Occasion for an Eye, as spending its Life in perfect Darkness; besides that the investing Membrane is not transparent, and therefore would obstruct the Sight.

SECT. XV.

At the Sides, where the lower Edges of the *Hemicrania* do not touch one another, there is a sort of Cavity; and in these Sides the harder Fibres may be distinguished, disposed in such a manner, as perfectly to resemble the Gills of Fish; and through them the Worm seems to breathe.

SECT. XVI.

The extreme Softness of the other Parts of the Head prevents our coming at the Knowledge of the Use of the Membranes furnished with *Fibres* of different Tendencies, or inquiring by what Organs the Worm takes the Wood shaved off by the *Hemicrania*, or rough Shells; whether it does this by Suction, or not; by what Muscles, or how acting,
this

this wonderful Head is moved. 'Tis probable, indeed, that its Motion consists in the opening and closing these Shells (SECT. VIII.) that shave off the Wood; and that the inner Parts have a Power to move on all Sides, as the Ball does in the Socket of the Eye; and perhaps to come forth of these Shells, and re-enter after taking their Food. But of these things there can be no Certainty, because the Parts dissolve between the Fingers.

SECT. XVII.

The Body, viewed forward, (Fig. 2.) is of a reddish Colour. In the middle appears a Line, often dark-brown, often blackish, sometimes not visible, sometimes running near half the Length. The rest of the Animal is of a whitish or grey Colour.

1. If you intend to dissect it, and examine the Inside, you must first remove a thin Membrane surrounding the whole Body, which for that Reason may be called the *Cutis* or *Cuticula*. When this is removed, there appears an oblong Vessel placed in the Middle, (Fig. 2.) of a reddish Colour, from the shaved Wood, of which it is full: Hence it seems to be the Stomach, or at least the first Organ of Digestion.

2. In the lower Part you will find another Vessel, appearing like a dark-brown Line, which contains the Excrements, of which it is often found full, and discharges them at the End of the Tail.

3. At the Sides of the reddish Vessel or Stomach (SECT. XVII. 1.) is placed a white, clammy, fat Substance, sticking to the Fingers, and perhaps constituting the Flesh of the Animal.

SECT. XVIII.

Where the Body ends, the Tail begins, thicker than the Body, and rendered stronger by circular *Fibres*. At its End it has two small hard Bodies, containing and defending the tender Extremities of the Tail.

This Tail thicker than the Body terminates in two Ends, the thickest of which certainly serves for the Discharge of the Excrements, the slenderest doubtless for Generation: And this it can stretch out to an incredible Length, so that in Worms that seemed to be in Copulation, it appeared above an Inch out of the Pile.

The two small Bodies, that contain these Ends of the Tail, are of a harder Substance than even the *Hemicrania*. The outer Part is gibbous, the inner hollowed. The lower End is bifid; whence I conjecture, that they serve the Animal for Feet, when it is mounting upright, or corroding the Wood; by leaning on them as on a Prop (Fig. 8.).

SECT. XIX.

The above-described Worm dwells now very securely in a restaceous Tube of a white Colour, which it exactly fills, yet so as to be able to move with Freedom. That Tube, like the Coverings of Snails, &c. daily grows with the Animal, from the Matter which perspires from its Body; whence it is sometimes found strait, sometimes bent, according to the Course which the Worm steered in corroding.

S E C T. XX.

As to their Generation, it is probable enough, that, analogous to that of other Insects, it is performed by Copulation of Male and Female: For they can so lengthen one End of their Tail, and thrust it out of the Pile, that they may copulate by that means. Then they lay their Eggs in the Water close to the Piles, to which they stick by their clammy viscid Matter, (such, for Example, as Frog's Spawn) and afterwards, by the Heat of the Sun, hatch the Worm, which immediately endeavours to get into the Pile (See SECT. II. and III.).

I could not observe the Difference of Sex, either with my Eye, or a Microscope. Some think them Hermaphrodites, as Snails, and that they copulate in the same Manner: But these Conjectures are not very probable.

S E C T. XXI.

Many Remedies and Secrets for destroying these dangerous Enemies were immediately boasted of, which for the most part were Preparations of *Arsenic* or *Mercury*, and are not worth enumerating: I will only give the Receipt of one, which is the best and surest of all.

Take an Iron Plate of an oblong Figure, and of the Width of the Pile, with a strong Handle at each End. One End of this Plate must be armed with thick Nails half an Inch long, and about an Inch asunder. The Nails of this Plate must be driven into a Pile of any light Wood, with a Hammer, and then the Plate pulled off by means of its Handles.

O o

And

And this is to be so often repeated until the Pile is perforated every-where with small Holes: Then it must be dawbed over with *Varnish* in the hottest Sun (the *Varnish* is imbibed by the soft Wood with so many Holes in it); and while the *Varnish* is yet hot, let it be strewed over with *Brick-dust*: And this is to be repeated three or four times, after the preceding *Varnish* is thorough dry, till the Pile is intirely surrounded with a stony Cruft, which will be impenetrable to all Insects, and last many Years.

But the Divine Clemency has already so far destroyed these pernicious Insects, which multiplied so prodigiously for eight or nine Years past, that there is great room for Hope, that our Country will in a short time be intirely freed from them.

An Explanation of TAB. II.

Fig. 1. The Pile-worm of its natural Size, lying on its Belly.

Fig. 2. The same lying on its Back.

See SECTION XVII.

A. The Stomach.

B. The Duft full of Excrements.

C. The Tail, with its Defences *dd*, and its Point *e*, which it can stretch out.

The Six following Figures are represented much larger than Life.

S E C T. X.

Fig. 3. *AA.* The first Series of Fibres running strait down,

BB.

BB. The second Series running transversely.

CC. The third taking a different Course.

DD. The lower Edge, which is infixed to the Head.

S E C T. XI.

Fig. 4. The Shell or *Hemicranium* seen on the Inside with the Process running cross it, one End of which *A* is fix'd, the other *a* is moveable.

S E C T. XII.

Fig. 5. *A.B.C.D.* The same as in Fig. 3.

E. The Hinge, whereby these are connected, and may easily dilate or open.

S E C T. XIII.

Fig. 6. *AA.* The Membrane covering the Head freed from the *Hemicrania*, which were attach'd to this Membrane.

B. The Place, where the *Hemicrania* were connected.

c. The middle anterior Part, in which the *Tubercle* was prominent.

S E C T. XIV.

Fig. 7. *AA.* The Membrane of Fig. 6. separated and turned back.

B. The pellucid pyriform Body lying in the middle of the Head, and which formed

c. The *Tubercle*.

S E C T. XVIII.

Fig. 8. The two Defences of the Tail, of which the exterior Part *A.* is gibbous, the other or interior *B.* is, as it were, hollowed: These Extremities are bifid. *C.* By this Part they are joined to the Tail.

VI. *Two Observations of Explosions in the Air; one heard at Halsted in Essex, by the Rev. Mr. A. Vievar, Minister of that Place; the other by Sam. Shepheard, Esq; of Springfield in the same County.*

ON Sunday the 12th of March 1731-2. between One and Two o'Clock in the Afternoon, walking in my Garden by the Side of a Canal, I heard as it had been a large Clap of Thunder from the North-East, being a very clear Day, and no Clouds appearing. While I was looking into the Air, the Noise was repeated very loud, but seemed more like the violent Fall of a House, insomuch that I expected every Moment an Out-cry from the Town: But I was soon undeceived, when it began again, and I found it made towards me, with a different Noise from what I had heard, that is, like the Grinding of Flint-stones, but very loud: The Dimensions of it seem'd to be about three Foot wide. I found it sink in the Air, and as it seem'd to point directly at my Head, I laid myself down upon a Grass-slope, to let it pass over me. However, at the upper End
of

of the Walk I found it fell to the Ground, and came rolling down the Grafs-walk ; and I can compare it to nothing better than to that of a violent Grinding of Flint-stones, or a Coach and Six upon the full Speed upon a Causeway of loose Stones. I lay attentive, expecting to see something, and saw a Piece of Wood came running before it. When the *Phænomenon* came to the Water-side, it twisted up a large Stake that stood in its way, and tossed it towards me with much Violence, and immediately fell into the Water with the Violence and the Noise of a red-hot Mill-stone. I have seen the Seas break against a Rock in a Storm, but never saw a greater Ferment caused by the boiling of the Waters. It staid about a Quarter of a Minute in the Water, and then mounted again into the Air, and went rattling away, but with much less Violence : I heard it for about a Quarter of a Mile, and lost it.—*N. B.* It came against the Wind, and not faster than a Man may walk. The Froth and Foam upon the Water remained thirty Hours after, when I shewed it to some Friends.

Halsted in Essex,
1731-2.

A. Vievar.

*Part of a Letter to W^m. Woodford, M. D.
Fellow of the College of Physicians, London.*

—UPON *Tuesday* the 15th Instant, between Eleven and Twelve, the Sun shining very bright and hot, without the least Cloud, the Wind to calm, that the Water was as smooth as Glass, I
was

was dressing in my little Room next the Garden, about forty Yards from the Canal, when I heard a very surprising Noise of Fire, resembling, as I told you at *London*, as if a very large Quantity of Oil had been thrown into a great Bonfire, burning in its greatest Rage. I stepp'd immediately to the Window which was open, where I saw the Middle of the Canal, which this dry Season has sunk about six Inches, in extreme Agitation, as rough as the *Thames* in a Storm, foaming and smooking, and forced up, to my Appearance, full two Foot above the Surface, but it might be much more, my Window being greatly higher than the Canal; and the Fellow who was at Work, whom I examined again this Morning, protests he saw the Water, like the Spray of the Sea, above the Dwarf-Trees, which must necessarily be five or six Foot. I wish I had seen the Beginning of this uncommon *Phænomenon*, the Duration of which, I think, might be half a Minute, and made the House stink, as if a Gun had been fired in it.

My Canal bears East and West, and the Fellow says he heard it coming from the West, bringing the Leaves of some tall Trees from an adjacent Field in its Passage; but could not discover any material or substantial Body to fall in the Water, where the Hissing, as I observed above, was very loud and violent; neither was there any Lightning or Thunder before or after, but the Day remain'd bright, still, and hot. I forgot to say, the Space of the Canal that was affected by it, might be twelve or fifteen Yards.

Springfield in Essex,
Aug. 22. 1732.

Sam. Shepheard.

TAB I

D

Philo Trans N° 456

Fig 2

B

Fig 1



TAB II.

Philo Trans N^o 456

Fig 2



A

B

Fig 1.

C

J. Mynde Julp

PHILOSOPHICAL TRANSACTIONS.

For the Months of *January, February, March, April,
May, and June, 1740.*

The CONTENTS.

- I. *A Catalogue of the FIFTY PLANTS from Chelsea Garden, presented to the ROYAL SOCIETY by the Company of Apothecaries, for the Year 1738. pursuant to the Direction of Sir Hans Sloane, Bart. Med. Reg. & Soc. Reg. Præf. By Isaac Rand, Apothecary, F. R. S. Hort. Chel. Præf. ac Prælec. Botan.*
- II. *Some Reflections on Generation, and on Monsters, with a Description of some particular Monsters: By Daniel de Superville, Privy-Counsellor and chief Physician to his most Serene Highness the Margrave of Brandenburg-Barceith, President of the College of Physicians, Director of the Mines and of all Medicinal Affairs in the Margravite, Member of the Imperial Academy Naturæ Curiosorum, and of the Royal Society of Berlin.*
- III. *Offis Bregmatis Gigantæ Magnitudinis Icon, TAB. I. Fig. 2. & TAB. II. Fig. 1. cum Problemate de Gigantis Statura determinanda secundum Regulas Artis Delinctoriæ: quæ ad Illustr. REGALIS SOCIETATIS Præsidentem Dum Hans Sloane, Bart. transmissit Jac. Theodor. Klein Reipubl. Gedan. a Secretis, & Reg. Soc. Lond. Soc.*
- IV. *An Account by the Rev. Zachary Pearce, D. D. F. R. S. of a Book intituled, Reflexions Critiques sur les Histoires des Anciens Peuples, &c. Paris, 1735. 4^o. in 2 Vol.*
- V. *A Query proposed to such curious Persons as use the Greenland Trade, occasioned by the annexed Letter from Mr. David Nicolson, Surgeon, to Dr. Mortimer, Sec. R. S. concerning Scurvy-grafts.*
- VI. *A Letter from Edmund Stone, F. R. S. to ——— concerning two Species of Lines of the Third Order, not mentioned by Sir Isaac Newton, nor Mr. Sterling.*
- VII. *An Account of an Improvement on the Terrestrial Globe, by Joseph Harris, Gent.*
- VIII. *A new Method of improving and perfecting Catadioptrical Telescopes, by forming the Speculum of Glass instead of Metal. By Caleb Smith.*
- IX. *Extratt of a Letter from the Honble Henry Temple, Esq; to his Father the Right Honble the Lord Viscount Palmeriton, concerning an Earthquake at Naples 1732. communicated to the Royal Society by Claudius Amyand, Esq; F. R. S. & Sergt. Surgeon to his MAJESTY.*

The CONTENTS.

- X. *A Letter from Mr. Timothy Speldrake to Sir Hans Sloane, Bart. Pr. R. S. &c. concerning a Monstrous Child born of a Woman under Sentence of Transportation.*
- XI. *A Paper concerning the Mola SALVIANI; or Sun-fish, and a Glue made of it; communicated by the Rev. Mr. William Barlow to the President of the Royal Society.*
- XII. *An Account of the Discovery of the Remains of a City underground, near Naples; communicated to the ROYAL SOCIETY by William Sloane, Esq; F. R. S.*
- XIII. *An Account of a Meteor seen in the Air in the Day-time, on Dec. 8. 1733; communicated by Mr. Crocker to Sir Hans Sloane, Bart. Pr. R. S. &c.*
- XIV. *An Account of a Luminous Appearance in the Sky, seen at London on Thursday March 13. 1734-5. by John Bevis, M. D.*
- XV. *An Account of the Case of a Calculus making its Way through an old Cicatrix in the Perinæum, by David Harley, M. A. F. R. S.*
- XVI. *An Account of a Stone, or Calculus, making its Way out through the Scrotum; communicated by Mr. John Sisley, Surgeon, to Sir Hans Sloane, Bart. Pr. R. S. &c.*
- XVII. *A Letter from Mr. Moreton Gilks, F. R. S. to Dr. Mortimer, Sec. R. S. giving some Account of the Petrefactions near Marlock Baths in Derbyshire; with his Conjectures concerning Petrefaction in General.*
- XVIII. *Part of a Letter from the Abbé Pluche to Dr. Mortimer, Sec. R. S. concerning the Smut of Corn.*
- XIX. *A Letter from John Bartram, M. D. to Peter Collinson, F. R. S. concerning a Cluster of small Teeth observed by him at the Root of each Fang or great Tooth in the Head of a Rattle-Snake, upon dissecting it.*
- XX. *Notices of some Meteor, observed at Philadelphia in North-America by Joseph Breinshall, extracted out of a Letter from him to the Same.*
- XXI. *A Description of the Cave of Kilcorny in the Barony of Burren in Ireland, contained in a Letter from Mr. Charles Lucas, Apothecary at Dublin, to Sir Hans Sloane, Bart. Pr. R. S. &c.*
- XXII. *The Case of Grace Lowdell, aged about Sixty Years, who had an extraordinary Tumour on her Thigh; communicated by John Chandler, F. R. S. from Mr. Mizael Malijalguerat, Surgeon, at St. Edmund's-bury.*
- XXIII. *An Extract of a Letter from Mr. James Short, of the College at Edinburgh, to Mr. Rich. Graham, F. R. S. of an Aurora Borealis.*
- XXIV. *A Letter from Mr. John Frecke, F. R. S. Surgeon to St. Bartholomew's Hospital, to the ROYAL SOCIETY, relating a Case of extraordinary Exostoses on the Back of a Boy.*

I. A

E R R A T A.

Page. 303. l. 11. *lege* TAB. I. Fig. 2. & TAB. II. Fig. 2.
12. *pro* adjuncta, *l. adjecta*.
34. *dele* (TAB. II.)

I. *A Catalogue of the FIFTY PLANTS from Chelsea Garden, presented to the ROYAL SOCIETY by the Company of Apothecaries, for the Year 1738. pursuant to the Direction of Sir Hans Sloane, Bart. Med. Reg. & Soc. Reg. Præf. By Isaac Rand, Apothecary, F. R. S. Hort. Chel. Præf. ac Prælec. Botan.*

801. A DONIS; Hellebori radice; Bupthalmi
flore. H. L. Bat.
802. Anonis Alopecuroides, mitis, annua
purpurascens. H. Elt. 28.
803. Asteriscus; Coronæ Solis flore & facie. H.
Elt. 42.
804. Carduus galactites. J. B. III. 54.
805. Caryophyllata Alpina, lutea. C. B. 322.
806. Chamælæa tricoccus. C. B. 462.
807. Chenopodium Ambrosioides; folio sinuato.
T. 506.
808. Chenopodium Ambrosioides, Mexicanum.
T. 506.
809. Clinopodium Americanum; Salicariæ foliis
perforatis; Pulegii odore.
810. Clinopodium; Menthæ folio, incanum &
odoratum. H. Elt. Tab. 74.
811. Cnicus Hispanicus, alboreus foetidissimus. T.
451.
812. Crocus, vernus, latifolius, flavus. C. B. 66.

813. Crocus Vernus latifolius; flore albo purpureo-violacea basi. C. B. 66.
814. Crocus albus variegatus; fundo floris flavescente.
815. Delphinium Plarani folio,
Staphysagria dictum. T. 428.
816. Doronicum Plantaginis folio. C. B. 184.
817. Eryngium coeruleum, albis maculis notatum, H. Ox. III. 165.
818. Eryngium montanum, Amethystinum. C. B. 386.
819. Hyoscyamus albus, major, vel *tertius* Dioscoridis, & *quartus* Plinii. C. B. 169.
820. Hyoscyamus major, albo similis; Umbilico floris atro-purpureo. T. Cor. 5.
821. Hyoscyamus luteus, minor frutescens.
822. Jasminum humilius, magno flore. C. B. 398.
823. Iris tuberosa; folio anguloso. C. B. 40.
824. Laspitium angustifolium majus; segmentis longioribus & indivisis. H. Ox. III. 321.
825. Laspitium foliis latioribus; semine crispo, & verrucoso. H. Ox. III. 320.
826. Laspitium humilius; Paludarii folio; flore albo. T. 325.
827. Laspitium; lobis angustioribus, & dilute virentibus, conjugatim positis. H. Ox. III. 321.
828. Laspitium; lobis angustioribus, longioribus & dilute virentibus, plurifariam divisis. Pluk. Phyt. Tab. 198. F. 6.
829. Laspitium, lobis minimis trifidis; seminum alis fere planis.

An *Laferpitium angustiore folio, umbella
concaua & contracta. Pluk. Phyt.*
Tab. 199.

830. *Lavandula angustifolia.* C. B. 216.

Lavendula Officinarum.

831. *Lavandula latifolia.* C. B. 216.

Spica Nardus Germanica. Trag.

832. *Leonurus minor; Capitis Bonæ Spei, vulgo.*
Boerh. 180.

833. *Limonium minimum; flagellis tortuosis,
nostras.*

834. *Linaria annua, angustifolia; flosculis albis,
longius caudatis.* Triumph.

835. *Matricaria vulgaris, seu fativa; caulibus ruben-
tibus.* H. L. Bat.

836. *Menispermum Canadense, scandens; umbi-
licato folio.* Ac. R. Sc. 1705.

837. *Menispermum; umbilicato folio, mucronato,
ad basin non sinuato.*

838. *Menispermum; Hederaceo folio.*

839. *Pinus, Halepensis; foliis tenuibus late viri-
dibus.*

840. *Polium erectum minus angustifolium.*

An *Polium Hispanicum tenuifolium, flore
albo, capitulo breviori.* T. 207.

841. *Populus nigra; folio maximo; gemmis Bal-
samum odoratissimum fundentibus.* Catef.
Hist. Tab. 34.

842. *Saxifraga, rotundifolia, alba.* C. B. 309.

843. *Saxifraga, verna, annua, humilior.* T. 252.

Sedum tridactylites tectorum. C. B.

844. *Serratula Marilandica; foliis glaucis Cirsi-
instar denticulatis.* H. Elt. 354.

845. Stramonium; foliis subrotundis sinuatis & denticulatis.
 846. Thapsia latifolia, villosa. C. B. 348.
 847. Verbena Bonariensis, altissima; Lavendulæ Canariensis spica multiplici. H. Elt.
 848. Virga aurea Marilandica, cæsia, glabra. H. Elt. 414.
 849. Virga aurea Novæ Angliæ, lato, rigidoque folio. Par. Bat.
 850. Virga aurea, vulgaris, latifolia. J. B. II. 1062.
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II. *Some Reflections on Generation, and on Monsters, with a Description of some particular Monsters: By Daniel de Superville, Privy Counsellor and chief Physician to his most Serene Highness the Margrave of Brandenburg-Bareith, President of the College of Physicians, Director of the Mines and of all Medicinal Affairs in the Margravite, Member of the Imperial Academy Naturæ Curiosorum, and of the Royal Society of Berlin. Translated from the French by Phil. Hen. Zollman, F. R. S.*

IT cannot be denied, that since the middle of last Century to this Time, very important Discoveries have been made in Natural History: However, those Discoveries are very insignificant, in comparison to what is still concealed from us. We have some
 Know-

Knowledge of the coarser sort of Nature's Operations, but the Niceties, the Particulars of them, escape us. If we endeavour to push our Knowledge so far, we find ourselves surrounded with Clouds, we grope in the dark, and it is very difficult, if not impossible, to catch Nature in the Fact. It even seems, we have had better Success in determining what Nature does not do, or cannot do, than in specifying what she actually does.

The Human Body is a Compound of Springs, which produce very regular Motions: Yet these Springs themselves we do not know but very superficially, and are far from knowing how those Motions are produced. We know, that we are born, that we exist; but how came we to this Existence? How were we produced? The Generation of Mankind and of Animals is one of those *Phænomena*, where innumerable Experiments have not been of so great Use, as they are else in other *Phænomena* of Natural Philosophy, for discovering their most secret Springs.

It is still a Dispute, whether the Male or the Female contributes most towards Generation. It is certain, that for the Generation of Mankind there must be a Male and a Female, and it is the same thing with regard to that of Brutes. There is all the Reason in the World to believe, that what is written about Hermaphrodites, and about those Animals which, being endued with the Advantage of the two Sexes, produce alone their Like, has not been examined with all the necessary Attention and Exactness.

The *Semen* of Man, which is certainly a most necessary Agent for Generation, because it has been
ob-

observed, that those who have none, or do not eject it according to certain requisite Conditions, are not fit for multiplying their own Species: This *Semen*, I say, is a Liquid full of small Worms. It would be absurd to deny it: All exact Observators have taken Notice of them, and offered to shew them to the incredulous. I have observed these *Animalcula* in human *Semen*, in that of several Quadrupedes, and in that of some Birds. I have observed, that the Figure of these *Animalcula*, as to Birds, was different from that of other Animals. I have preserved *Animalcula* in a proportionable Warmth alive for several Hours; I have observed their Strength and Liveliness to lessen by Degrees, and at last intirely to cease; and I have observed them dead, not swimming any longer, but always sinking to the Bottom. I have observed in the *Semen* of Men, who had a virulent *Gonorrhœa* upon them, those *Animalcula* to be without Motion, and like dead. I might enlarge upon the Particulars of a greater Number of Observations; they all prove the real and constant Existence of *Animalcula* in the *Semen* of Males.

These Worms, according to some Natural Philosophers, are true *Embryoes*. As soon as an *Animalculum* has entered into an Egg, the Female who carries the Egg in her Body, has conceived; she harbours it, nourishes it, and contributes towards the shaping of it, until it becomes an Animal, too big to be any longer contained in so small a Place, and strong enough to bear the Air.

According to other Natural Philosophers, the Eggs that are in the *Ovaria* of the Females, contain the Image, the Type, the Picture of the *Embryo*; and the
subtile

subtile Vapour of the Male *Semen*, or rather the occult Quality of that Seed, impregnating one of those Eggs, immediately fixes that Image, and makes a real *Embryo* of it.

These latter intirely deny the Existence of *Animalcula* in the Seed, because they have not seen them; and if they are shewn them, they maintain that they are foreign Beings; or, that they are a particular sort of Worms, who form a separate Class among those Insects: That God created them to exist in the Seminal Liquid, that they keep in it as in their Element, that they multiply there, and that they continue there and die, such as we observe them by the Microscope.

I do not pretend to decide, that the former are intirely in the Right; they maintain an Hypothesis founded on some Probabilities. Alas! who can hope upon so dark and hidden a Subject to find a demonstrated System? The second Opinion seems to me unwarrantable: It is founded upon Words which have no Reality. How can one form to himself the Idea of a Vapour extremely subtile and active, that shall have the Faculty of giving Life and Motion to an Image, to a Type, in short, to a thing that was not real? The Pre-existence of the *Embryo* in the Egg can by no means be demonstrated: Even by the Help of the best Microscopes, there is never any thing found in those Eggs, but a clear and limpid Liquid.

I keep among my Curiosities six ossified Eggs, which I found in the *Ovaria* of a Woman who died at the Age of Sixty. They are not all of the same Bigness. I broke two of them, and examined their

their internal Structure with all the Attention imaginable; but found nothing there except offeous Fibres, issuing from the Centre towards the Superficies; there was not the least Appearance of an *Embryo*, nor of its Image.

One must have an Imagination extremely prepossessed to persuade one's self, that there is an organized Body in the Liquid contained in those Eggs: Or, it requires a very particular Natural Philosophy, to pretend to demonstrate, that a bare Vapour (more subtile than any the most spirituous Vapours we know of) could, by its simple Touch or Friction, produce an organized Body, where there was none.

The Generation of Mankind as well as of Brutes by the means of the *Animalcula*, which are observed in the *Semen* of Males, seems more analogous to all that we see Nature do for the Production and Multiplication of the Vegetables. There needs no Imagination for forming to one's self an Idea of it. Each *Animalculum* is an *Embryo*, is a small Animal of the same Species with that which harbours it: As soon as it finds itself disengaged from the Confinement in which it was, and in a Place where it meets with a Humour proper for its Vegetation and Expansion, it takes Root there, it swells like a Corn newly put into the Earth, it spreads itself, its Members shape themselves, and by degrees take more Strength and Consistence, its Parts grow longer, and disentangle themselves, as it were, from all those Plaits and Folds in which they were confined before, and the *Embryo* becomes a *Fœtus*.

I own, that the immense Number of *Animalcula*, which are observed in the Seminal Liquid of Man, seems

seems to oblige one to reject this Hypothesis, and particularly this Opinion, that every *Animalculum* is an *Embryo*. For it is certain, that in every Man there would be enough of them to people a vast Country, and of all that immense Quantity there are but a few that come to any thing. And so, there you have Millions of little Men, created never to exist; which seems directly contrary to the wise Intentions of the CREATOR, who, in all Likelihood, made nothing in vain. But *Teleology* is one of those Parts of Philosophy, in which there has been but little Progress made, wherein one reasons only by Conjecture, nor can demonstrate any thing otherwise than *à posteriori*. Who dares presume so far as to pretend to penetrate into all the Designs of the ALMIGHTY, and into the divers Ends He has proposed to Himself in the Creation of the Universe? Besides, it is certain, that half of Mankind perish, before they come to the Age of one Year, that is to say, before they can know themselves, before they can answer the Ends God proposed to Himself when He created them. Would one say therefore, that their Existence was useless? But moreover, this seemingly useless Quantity of *Animalcula* equally affords an Argument against the Hypothesis of those, who believe the *Embryo* is in the Egg. One cannot maintain, that all the Eggs in the *Ovaria* are fruitful. And so there we have equally an immense Quantity of Types of *Embryo's* created for nothing, and absolutely useless; and it will follow from both Hypotheses, that God might have saved Himself the Trouble of creating so prodigious a Quantity of Creatures in order to precipitate them into nothing. But who

dares say, that the creating so many Millions of Creatures more has cost Him any more Pains? And by what could one prove, that all those *Animalcula*, which do not come to the State of a *Fœtus*, are annihilated?

The Hypothesis of the Generation by *Animalcula* in the Seminal Liquid of Man, appears supported and confirmed by several Experiments. *Leewenhoek* has already observed, that a wild Male Rabber, and a tame and white Female, produce young ones intirely resembling the Father; and that it is a Cheat very common in *Holland* to sell that sort of Rabbits, for wild ones, and that it is only by the Taste one can find out the Truth. There is among domestic Animals a sort of Poultry without Tails, and another sort with the Feathers turned upwards; if a Cock without a Tail is put among ordinary Hens, or a Cock with the Feathers upwards, all the Chicks will prove like the Cock: The same Experiment may be made with Pigeons, with Canary-Birds, &c.— A Mule sprung from an Ass and a Mare, resembles more to the Ass than to the Mare, whereas a Mule coming from a Horse and a She-Ass, has more of the Horse's Nature. All this proves in some measure, that the Male furnishes the most essential Part in the Generation, *viz.* the *Embryo*.

By the same Hypothesis some *Phænomena* observed in Generation, may be more easily accounted for. *Hippocrates* believed that the Difference of the Sexes depended on certain Dispositions in the Seeds of the Male and the Female; that when the Male was the most vigorous in the Copulation, they begot Males; but if the Seed of the Female prevailed, they produced

duced only Females. This Opinion, absurd as it is, has been followed and maintained by several celebrated Physicians. How can one believe, that a little more of I do not know what, (for they do not determine wherein the more or less of the Virtue in the Seed must consist) a little more Activity, a little more Spirituousness, should compose, should determine any Organization? It is more natural to believe, that every *Animalculum* has already the Sex it is to have when it comes into the World. It has been disputed Tooth and Nail, to determine the Time when the *Fœtus* becomes animated, and to know from whence and how its Soul enters into its Body. According to the most general Opinion, there must be at every Conception a new Creation of a Soul: Or, according to others, there is always a Legion of created Souls fluttering about in the Air, and watching the Minute for entering into a fruitful Egg as soon as it is impregnated. What an Extravagance is this! Would it be as absurd to believe, that every *Animalculum* has already its Soul, which waits only for the little Machine's unfolding itself in order to exert its Function?

According to the Hypothesis of *Animalcula*, one may easily account for those monstrous Births, when two *Fœtuses* are joined together, or Children and Animals are double, in the Whole or in Part. I keep in my Collection a Pig, that has eight Feet; the two Bodies, that are separated, reunite themselves by the *Spina Dorſi* below the *Diaphragma*, and have but one visible Neck supporting a Head, bigger than it should be, on which there appear four Ears, three Eyes, and the Snout seems double. I have also

the Head of a Foal, which is double, and has three Eyes. I have a *Turkish* Duck, which is double, the two Bodies are joined by the Breast; each Body has two Wings, and two Legs; but they have only one Neck with one Head. I keep a Chicken, which has a second Rump fixed to its Breast, with the two Legs, and two Paws. I even have a Frog, which besides its four Paws, has a Fifth as well formed as the others, which comes out at the Right Shoulder. The Production of all these Monsters that are double, or have superfluous Members, may very well be occasioned by two *Animalcula* entering into the same Egg; they touch, they close, they unite, they crowd each other: The Parts of the weakest, being too much crowded, cannot extend nor display themselves; so they vanish, as it were, so much the easier as they are extremely tender, and without any sensible Consistency.

It is not more difficult to find plausible Reasons for imperfect Monsters, or that have an odd Conformity, as to the Whole, or as to some of the Members. I have the *Fætus* of a Sheep which has no Nose; the Part where the Nostrils should be, seems to be flayed, and the two Eyes are there one by the Side of the other. On the Forehead there is a small Trunk of about an Inch and a half long, and pierced at the End by two Nostrils. I have another, which has but one Eye in the Middle of the Forehead. I have a human *Fætus* of about seven Months, which has no Mark of the Sex, and instead of the Legs there is a Bag that runs to a Point, the Extremity of which is cartilagineous: In that Bag there is a Bone three Inches long, covered with a muscular Flesh; it

it is articulated with the *Os Sacrum*; the *Ossa innominata* are wanting, and below the *Anus*, which is upon the Middle of the *Os Sacrum*, there is a small Tail like that of a Pig.

When I was at *Stetin* in *Pomerania*, about 12 or 14 Years ago, a Midwife came to tell me, that a Sergeant's Wife was delivered of three dead Children, one of which had no Head. I immediately went, and observed, that these *Fætuses* had died at different times. One began already to corrupt, and the *Epidermis* fevered itself at the least Touch. The Monster without a Head was also already quite flabby, and the third seemed to have died but a few Hours before. I examined the Monster; there was no Appearance of any Head, and instead of the Navel there was a small Lump of spongy Flesh of the Bigness of a large Strawberry. About the *Secundines* I found but two *Placentas*, and two Coats; so that this Monster must absolutely have been in one of those Coats with another *Fætus*. The Midwife was not skilful enough to give me an Account of the Delivery: I put Questions to the Mother, who assured me she felt one Child dying three Weeks before, and that the last died the Evening before. I offered a good Sum of Money to have all she was delivered of, but they would not let me have it. I still offered Money to have only Permission to dissect the Monster, but the impertinent Superstition of the Parents deprived me of that Satisfaction.

I still preserve in my Collection a monstrous *Fætus*, which deserves particular Attention. It is of eight Months, without Head or Arms: The Figure [See TAB. I. Fig. 1.] is here annexed, which outwardly

wardly seems to be nothing else but the *Abdomen* with the Legs; these are well-shaped and proportioned, with the Toes, and the Beginning of the Nails; the Right Foot however is, as it were, crooked, and bending inwards. Having opened it, I found indeed but one Cavity, which in the upper Part contains a small Bladder. There is not in all the Cavity any thing besides a Bit of Intestine, the two Kidneys, the Bladder, and the Right Testicle, which lay upon the Ring. The Flesh was hard, and, as it were, *carcinomatose*. The Navel-string went in a little higher than naturally, and a little towards the Right Side, entering into the Intestine. There is a slender Intestine of about 14 Lines in Length, proceeding from the same Place, where the Navel entered into the Cavity; next comes the *Cæcum* with its vermicular Appendix, the *Colon* and the *Rectum*, the Whole together of the Length of about two Feet. These Intestines go from above to below in *Zic-Zac*, and are attached to the *Spina Dorsi*. There is no Footstep of the Heart, the Lungs, the Stomach, the Liver, the Spleen, the Pancreas, the Mesentery; all that is wanting. The small Bladder I mentioned was fleshy, and contained some Serosity; it is attached to the first of the *Vertebras* of the Neck. This Beginning of the *Spina* is bent forwards like a Bow, and forms the Monster's Roundness from above. The bended Extremity kept the little Bladder, as it were, under, and shut up in the Cavity closed up by the Ribs. This Cavity was to form the *Thorax*, but the *Sternum* was wanting as well as the *Diaphragm*.

Descartes and *Lancisci* would in vain have looked out here for the Seat of the Soul, and the *Punctum Saliens* would prove very hard to be determined in this *Fœtus*. But I do not now intend to enlarge upon it. The Business is to find some plausible Reasons about the Origin of those sorts of Monsters I have now described.

The Opinions of most of the Natural Philosophers on this head may, upon the main, be reduced to these two Hypotheses: 1. That Monsters are original, that is to say, that even in Conception the Monster is conceived. 2. That they are not produced but by Accident. One may conclude from what I have said about double Monsters, that I believed them accidental; and I believe, rigorously speaking, they are so, whatever they be: For supposing every *Animalculum* to be an *Embryo* created, I cannot imagine them to be created imperfect. Their Imperfection, their Deformity, may proceed from a thousand Accidents, either in the *Reservoirs* where they are contained, or in the different Routs they are obliged to take going from Father to Son. In this Case it may easily happen, that they are Monsters, even in the Moment of Conception, though they be such by Accident. To how many Accidents are they not subject afterwards in the Venter of the Females? A Fall of the Mother, a strong Pressure, a Contusion, &c. may disorder the nice and tender Structure of that little Creature so far, that a great many of its Parts do not unfold themselves any longer, are destroyed, or have their Order and natural Situation intirely changed.

The disturbed and disordered Imagination of the Females ought also to be ranged among the accidental Causes of Monsters. I have seen in a Sow just slaughtered seven Pigs, which all had the bloody Mark of the Knife about their Necks. About some twenty Years ago, a Cloth-shearer in *Holland* had the Misfortune to fall into the Hands of some drunken young Fellows, who murdered him, and stabbed him with more than twenty Wounds with their Swords. He was to be married that very Week: His Sweat-heart saw his Corpse naked with all those Wounds, and was two Days after delivered of a dead Child, which had the Marks of the Wounds in the same Places of its Body, where the Mother had observed them on her dead Lover.

I very well know, that these sorts of Instances, of which one might alledge some Hundreds, will not go down with certain People, who deny the Effect of the Mother's Imagination on the *Fœtus*. They lay Stress on two principal Reasons: 1st, It is pretended, that the *Fœtus* has no immediate Connexion with the Mother who carries it. But this is ridiculous; for one cannot deny, that the *Secundines* are closely united to the *Matrix*, and receive from the Mother a Humour, or a Liquid, which by the Navel-string it remits to the *Fœtus*. It is by that way it receives its Nourishment, that is to say, the Matter necessary for its Increase. Accordingly one may say, that the *Fœtus* owes part of its Being to the Mother; and that the Liquid which runs in the Vessels of the Mother, runs likewise in the Vessels of the *Fœtus*. 2^{dly}, It is said, that it is incomprehensible how the Soul of the Mother can have an Effect on
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the Child. I own I do not comprehend it neither. It does not follow from thence, that we ought to reject as false all that our Reason cannot penetrate into. When once the Existence and the Nature of the Soul has been demonstrated, when once we have a perfect Knowledge of the Manner how an immaterial Being acts upon Matter, we shall then reason in Consequence about what the Soul can do, and cannot do. Daily Observations demonstrate to us, that the disordered and disturbed Imagination of Women often hurts the Infants. And this is a Reason, which I add to all the others, to think I have good Grounds to conjecture, that all Monsters are accidental; and to believe, that by the Hypothesis of *Animalcula* one may better explain the *Phænomena* which are observed in Generation, than by any other Hypothesis known as yet.

III. *Offis Bregmatis Gigantææ Magnitudinis Icon; cum Problemate de Gigantis Statura determinanda secundum Regulas Artis Delineatorię: quæ ad Illustr. REGALIS SOCIETATIS Præsidentem D^{um} Hans Sloane, Bart. transmisit Jac. Theodor. Klein Reipubl. Gedan. a Secretis & Reg. Soc. Lond. Soc.*

EX celebri musco, quod Amstelodami fuit, Wittseniano, os bregmatis giganteum *, cujus altitudo 9 poll. Angl. latitudo 7 (TAB. I.) una cum descriptione & adjuncta figura †, altitudinem capitis amento ad verticem 20 poll. latitudinem ad tempora 12 poll. (TAB. II.) repræsentante, necnon aliud ejusmodi os, cujus altitudo $5\frac{6}{8}$ poll. Angl. latitudo 5 poll. sed sine figura & relatione ad caput anno 1728 nactus, facile invenire potui, assumtis secundum regulas artis delineatorię octo capitis altitudinibus, staturam gigantis fuisse 13 ped. 4 poll. alterius vero offis bregmatis, quod insolitum quoque simulabat caput, justam rationem & quidem juxta regulas mathematicas scire cupidus, viro excellentissimo *Henrico Kühn*, J. U. D. & Athenæi *Dantiscani* mathes. P. P. meritissimo, sequens proposui Problema :

* *Vid. Catal. Mus. Wittsen. p. 82.*

† A pie defuncto *Ruyfchio* comparatis.

Si in duobus corporibus humanis diversæ staturæ fuerit,

In Priore,

Ossis bregmatis altitudo 9 poll. Angli.

————latitudo 7.

Integri capitis altitudo 20.

————latitudo 12.

In Posteriore,

Ossis bregmatis altitudo $5\frac{6}{8}$ seu $\frac{46}{8}$ poll. Angli

————latitudo 5.

Integri capitis altitudo ignota.

————latitudo ignota.

Determinare ignotum, & rationem staturæ prioris ad posteriorem definire.

CUJUS TRIPLEX RESOLUTIO, hæc:

Si corpora ista forent similia, res brevissime expediri posset, inferendo; ut in priore corpore, ossis bregmatis altitudo ad integri capitis, vel etiam integri corporis, (tanquam illius octuplam) altitudinem, ita in posteriore corpore, ossis bregmatis altitudo vel latitudo ad integri capitis, vel etiam integri corporis, altitudinem quæsitam; quoniam vero 9 ad 7, & $\frac{46}{8}$ ad 5 sunt rationes dissimiles, corpora ista similia non sunt. Quamobrem opus est, ut in calculo & altitudinum & latitudinum ossium bregmatis ratio habeatur; uti ex triplici methodo subiecta apparebit.

METHODUS PRIMA.

$$(Fiat \alpha.) \quad 9'' : 20'' = \frac{46''}{8} : \left\{ \begin{array}{l} \text{altitud. capitis quæsitam} \\ \frac{20 \cdot 46''}{9 \cdot 8} \end{array} \right.$$

$$\text{erit hujus octuplum} = \frac{8 \cdot 20 \cdot 46''}{9 \cdot 8} = \frac{20 \cdot 46''}{9} = \frac{920''}{9}$$

$$= 102 \frac{2}{9} \quad \left\{ \begin{array}{l} = 8 \text{ ped. } 6 \frac{2}{9} \text{ poll.} \\ = \text{staturæ corporis secundi.} \end{array} \right.$$

$$(Fiat \beta.) \quad 7'' : 20'' = 5'' : \left\{ \begin{array}{l} \text{altitud. capitis quæsitam;} \\ \frac{100''}{7} \end{array} \right.$$

$$\text{erit hujus octuplum} = \frac{800''}{7} = 114 \frac{2}{7} = 9 \text{ ped. } 6 \frac{2}{7} \text{ poll.}$$

$$= \text{staturæ corporis secundi.}$$

$$(Fiat \gamma.) \quad \text{Staturarum inventarum additio, \& summæ} \\ \text{bifectio, pro obtinendo medio arithmetico, erit} \\ \frac{8', 6'' \frac{2}{9} + 9', 6'' \frac{2}{7}}{2} = \frac{17', 12'' \frac{1}{2}}{2} \text{ quam prox.}$$

$$= \frac{18' + \frac{1}{2}''}{2} \quad \left\{ \begin{array}{l} = 9 \text{ ped. } \frac{1}{4} \text{ poll.} \\ = \text{structuræ corporis secundi} \\ \text{proxime veræ.} \end{array} \right.$$

METHODUS SECUNDA.

(Fiat) $9'' \mp 7'' : \frac{46''}{8} \mp 5'' = 20'' : \text{altitud. capitis}$
[posterioris.]

$$\text{h. e. } 16 : \frac{46 \mp 40}{8} = 20'' : \dots$$

$$\text{h. e. } 16 : \frac{86}{8} = 20'' : \left\{ \begin{array}{l} \text{altitud. capitis posterioris} \\ \frac{20. 86''}{16. 8} = \frac{5. 86''}{4. 8} = \frac{430''}{32} = \frac{215''}{16} \end{array} \right.$$

$$\text{erit hujus octuplum} = \frac{8. 215''}{16} = \frac{215''}{2} = 107'' \frac{1}{2}$$

$$\left\{ \begin{array}{l} = 8 \text{ ped. } 11 \frac{1}{2} \text{ poll.} \\ = \text{staturæ corporis fe-} \\ \text{cundi proxime veræ.} \end{array} \right.$$

Id quod cum priori calculo sic satis consentit, cum
 differentia $\frac{3}{4}$ pollicis non excedat.

METHODUS TERTIA.

Quoniam in diversorum corporum partibus cog-
 nominiis (e.g. in duobus ossibus bregmatis) super-
 ficies partium sunt inter se, ut quadrata altitudinum
 corporum integrorum; nec minus superficies istæ sint
 inter se, ut facta ex altitudinibus partium in latitu-
 dines: erunt etiam facta ex altitudinibus partium in
 suas latitudines inter se, ut quadrata altitudinum cor-
 porum integrorum. Quare, cum altitudo corporis
 prioris sit $20''$, adeoque ejus octuplum, seu altitudo

integri corporis prioris, fit $160''$, cujus quadratum est $25600''$; fiat

altitd. bregmat. prioris. in ejus latitud.	altitd. bregm. poster. in ejus latitud.	quadratum alti- tudinis, prioris corporis integri.	quadratum alti- tudinis, poste- rioris corporis integri.
9 . 7	$:\frac{46}{8}$.	$5 = 25600$	

$$\text{h. e. } 63 : \frac{230}{8} = 25600'' : \frac{230 \cdot 25600''}{63 \cdot 8} = \frac{230 \cdot 3200''}{63}$$

$$\text{Cum itaque fit } \frac{230 \cdot 3200''}{63} = \frac{736000''}{63} = 11682'' \frac{1}{2}$$

quam proxime, = quadrato staturæ corporis secundi; erit (radice quadrata ex 11682 extracta) ipsa corporis secundi statura quam proxime vera = 108 = 9 ped. 0 poll. Angl. Quæ ipsa statura, cum sit inter supra inventas media, pro accuratissima est habenda.

Denique, cum octo capitis altitudines pro statura corporis humani integri satis recte assumere soleamus, & capitis giganti prioris altitudo sit 20 poll. Angl. erit statura gigantis prioris = $8 \cdot 20'' = 160'' = 13 \text{ ped. } 4 \text{ poll. Angl.}$ Consequenter statura gigantis prioris est ad staturam posterioris, ut 13 *pedes*, 4 *pollices* ad 9 *pedes* in mensura Anglicana, seu ut 160'' ad 180'' seu ut 40 ad 27.

IV. *An Account by the Rev. Zachary Pearce, D. D. F. R. S. of a Book intituled, Reflexions Critiques sur les Histoires des Anciens Peuples, &c. Paris 1735. 4^o. in 2 Vol.*

MONS. *Fourmont* is well known to the learned World for some curious Pieces which he has already published, and for very many others in almost all Languages, which he has prepared for the Press, and the Titles of which he has given us in a Catalogue of his Works printed at *Amsterdam* 1731. in 8vo.

This Work of his, which now lies before the Society, is intituled, *Reflexions Critiques sur les Histoires des Anciens Peuples, &c.* lately printed at *Paris*, in 2 Vols. in 4to, at the Expence of some *French* Gentlemen of his Acquaintance, as he tells us in the *Advertisement* placed before his *Preface*.

His general Design is to set right the History of the most antient Nations, particularly the *Chaldeans, Hebrews, Phœnicians, Egyptians, Greeks, &c.* down to the Time of *Cyrus* the Founder of the *Persian* Empire.

The Work consists of three Books.

In the First of which he gives us at Length the famous Fragment of *Sanhoniathon* the *Phœnician*, as translated by *Philo Byblius*, and preserved by *Eusebius* in his *Præparatio Evangelica*, Lib. I. cap. 9.

With this Fragment he has published a *French* Version of it, in which he endeavours to distinguish between the Account given by *Sanhoniathon* the

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Author, and what he supposes to be the Additions of *Philo* the Greek Translator.

After this he examines into the Reasons brought by several of the Learned *for* and *against* the Genuineness of the Fragment, and determines in favour of it with as much Weight of Argument as the Question will admit. He then takes Notice of a Treatise, written on the same Subject as his own, by our learned Countryman Bishop *Cumberland*; and having examined and declared his Dislike of the Bishop's Scheme in the main, he prepares his Reader to expect full Satisfaction from his own, which makes the Subject of his second Book.

In his second Book, he undertakes to reconcile the Generations of Men set forth in *Sanhoniathon's* Fragment, with those which are recorded by *Moses* of the Patriarchs before and for some time after the Flood.

By the Help of *Hebrew*, *Phœnician* and *Egyptian* Etymologies, he often makes the Names, which at first Sight are almost all quite unlike, to be the same in Sound, or at least in Sense. And by this Application of his Skill in the antient Languages, he readily finds out a Coincidence between *Moses's* and *Sanhoniathon's* earliest Generations.

But his main Work, and what he appears most pleased with, is his Discovery of *Abraham* and his Family among the later Generations recorded by *Sanhoniathon*. Having laid down (upon good Grounds, as he assures us) that *Ouranos* is *Terah*, the Father of *Abraham*, he undertakes to prove, that *Abraham* is the *Cronus* of *Sanhoniathon* and the *Saturnus* of the *Latins*; that *Sarah* (his Wife) is the
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the same with the Goddess *Rhea* ; that *Ismael* (*Abraham's* Son) is the *Mith* of *Sanhoniathon*, and the *Dis* or *Pluto* of the *Greeks* and *Romans* : That *Isaac* (*Abraham's* other Son) is the same with the *Sadid* of *Sanhoniathon*, with *Jupiter* among the *Latins*, and *Zeus* among the *Greeks*, his Wife *Rebecca* being *Juno* ; that *Esau* (*Isaac's* eldest Son), is *Osiris* and *Bacchus*, and that *Jacob* (the youngest) is *Typhon*. And, in like manner, he finds a very great Part of the *Grecian* Theology in *Abraham's* Family.

In the mean while his Readers will, perhaps, make two very material Observations on this extraordinary Discovery of his : The one, that *Cronus's* Character in *Sanhoniathon's* Fragment, is the most immoral and tyrannous of any recorded there : And how to reconcile this with the Character given in Scripture to *Abraham*, as *the Friend of God*, *the Father of the Faithful*, &c. is no easy Task : It requires (to be sure, more than a Resemblance of two or three Circumstances, common to *Cronus* and *Abraham*, when their Historians in Fifty other Circumstances make their Characters essentially different. The other Consideration, which occurs, when we read this Treatise, is, that *Abraham* had ill Luck indeed, if, when he left his native Country because of the Rise of Idolatry there, all the grosser Idolatry of the Heathen Nations after his Time took its Rise from him and his Family : The very Crime which he took Pains to avoid, he was the accidental Occasion of, if he and his are to be thus placed at the Head of the Heathen Theology.

The Author, having finished this remarkable Part of his Work, enters into a very learned Detail of the particular Gods of the several Heathen Nations, who are most celebrated in History ; and he has shewed a great Compass of Reading upon this Occasion. Hardly any Writer has been more copious on the Subject, or has given better Hints for clearing up many Passages of sacred and profane Story.

In his third Book he has treated at large about the Dynasties of *Egypt*, and the Shepherd-Kings who reigned there : Both of them, perhaps, the darkest Spots in the whole Face of Antiquity. He has taken great Pains to fix the Epochs of the Kings of *Sicyon*, *Sidon* and *Tyre*, of *Arabia*, *Assyria*, *Lydia*, of the *Medes* and *Babylonians* ; concerning all which he has laid together the most remarkable Testimonies of the Ancients. At length he comes to his favourite Point, the *Chinese* History, and gives us (as he says) a complete List of their Kings, from the Flood down to the present Monarch of that Empire, and shews that the Chronology of the *Chinese* may be made pretty nearly consistent with the true Chronology of the *Old Testament*.

And for this Part of the Work the Author seems well fitted, being skill'd (as he tells us in his *Preface*) in the learned Characters of that Country, which he has studied for near twenty Years, and has for some time taught in the Royal College at *Paris* ; and having composed five Dictionaries, and a Grammar of that Language, together with a Translation, almost intire, of the Geography of *Tamim*, which contains no less than the whole History of that Empire : On which Occasion he applies to himself, and
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the Progress which he has made in the *Chinese* Learning, those expressive Verses of *Virgil* in his Sixth Book of the *Æneid*:

——— *Pauci, quos æquis amavit*
Jupiter, aut ardens evexit ad æthera virtus,
Dius geniti, potuere.

V. *A Query proposed to such curious Persons as use the Greenland Trade, occasioned by the annexed Letter from Mr. David Nicolson, Surgeon, to Dr. Mortimer, Sec. R.S.*

“ **W**HETHER the *Scurvy-grass* of *Greenland* be the
 “ same Species, as to its external Appearance,
 “ with the common *Scurvy-grass* of *England*?
 “ And, having no acrid Taste while growing in
 “ *Greenland*, doth it, being brought growing in
 “ Earth from *Greenland*, gradually acquire an acrid
 “ Taste, as it is brought into a warmer Climate?”

S I R,

London, Dec. 16. 1730.

I Communicate this as Matter of Truth, and not Hypothetic, viz. That the *Scurvy-grass* in *Greenland*, equally the same with ours in *England*, as to the Figure of the Plant, and all its Appearance to the Eye, changes its Nature much, as it approaches the Sun; for in that Climate, its principal Quality, the volatile Salt, is neither pungent nor perceivable; but to the Taste, the whole Plant is intirely as insipid as the Colwort or Beet. So by my Endeavour,

I preserved some Plants with their natural Earth, and brought them to *London* alive; and I observed the remarkable Change produced by the Sun's Heat on them; for the saline Matter in *Greenland*, which certainly was analogous to a fix'd Salt, became, in a Month's time, almost to the same Volatility as that which naturally grows in *England*.

This I make mention of, in case other Gentlemen, who have had the same Opportunity, have been remiss in their Curiosity.

David Nicolson.

VI. *A Letter from Edmund Stone, F. R. S. to ——— concerning two Species of Lines of the Third Order, not mentioned by Sir Isaac Newton, nor Mr. Sterling.*

S I R,

July 31. 1736.

HAVING for some time past been reading and considering the little Treatise of Sir *Isaac Newton*, intituled, *Enumeratio Linearum tertii Ordinis*, as also the ingenious Piece of Mr. *Sterling*, called, *Illustratio Tractatus Domini Newtoni Linearum tertii Ordinis*; I have observed, that they have neither of them taken Notice of the two following Species of Lines of the Third Order; and venture to affirm, that the Seventy-two Species mentioned by Sir *Isaac*, together with the Four more of Mr. *Sterling*, and these Two, making in all Seventy-eight, is the exact Number of the different Species of

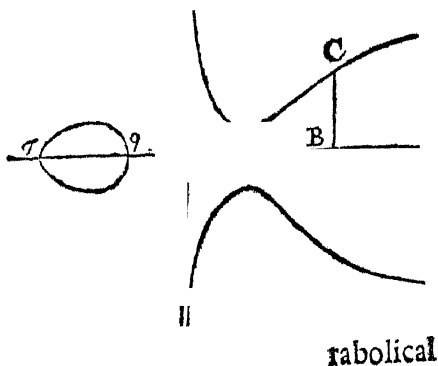
of the Lines of the Third Order, according to what Sir *Isaac* has thought fit to constitute a different Species.

The two Species I mean, are to be reckoned amongst the Hyperbolo-parabolical Curves, having one Diameter, and one Asymptote, at N^o. 8. of *Newton's* Treatise, or Page 104. of Mr. *Sterling's*, whose Equation is $xyy = \pm bx^2 \pm cx \pm d$; which will give, not Four, as in these Authors, but Six Species of these Curves: For,

I. If the Equation $bx^2 \pm cx + d = 0$, has two impossible Roots, the Equation $xyy = bx^2 \pm cx + d$, will (as they say) give two Hyperbolo-parabolical Figures equally distant on each side the Diameter *AB*. See the 57th Figure in *Newton's* Treatise, and this is his 53d Species, and *Sterling's* 57th.

II. If the Equation $bx^2 - cx + d = 0$, has two equal Roots both with the Sign $+$; the Equation $xyy = bx^2 - cx + d$, will (as they say) give two Hyperbolo-parabolical Curves crossing each other at the Point τ in the Diameter. See Fig. the 58th in *Newton*; and this is his 54th Species, and *Sterling's* 58th.

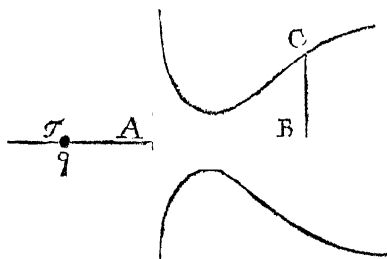
III. But if the Equation $bx^2 + cx + d = 0$, has two possible unequal negative Roots $A\rho$ and $A\tau$, the Curve given by the Equation $xyy = \pm bx^2 + cx + d$, will consist of two Hyperbolo-pa-



rabolical

rabolical Parts, as also of an Oval on the contrary Side the Asymptote or principal Absciss. And this is one of the Species omitted by Sir *Isaac* and Mr. *Sterling*, which is really the 59th Species.

IV. Also if the Equation $bx^2 + cx + d = 0$, has two equal negative Roots $A\rho$ and $A\tau$; the Curve given by the Equation $xyy = +bx + cx + d$, will consist of two Hyperbolo-parabolical Parts, and also of a Conjugate



Point on the contrary Side the Asymptote or principal Ordinate: And this is the other Species of these Curves omitted by Sir *Isaac* and Mr. *Sterling*, which is really the 60th Species.

V. If the Roots of the Equation $bx^2 - cx + d = 0$, are real, and unequal, having both the Sign $+$; the Curve given by the Equation $xyy = bx^2 - cx + d$, will (as they say) consist of a conchoidal Hyperbola and a Parabola, on the same Side the Asymptote or principal Ordinate. See Fig. the 59th in *Newton*; and this is really the 61st Species.

VI. If the Roots of the Equation $bx^2 + cx - d = 0$, have contrary Signs, the Equation $xyy = bx^2 + cx - d$, will (as they say) give a conchoidal Hyperbola with a Parabola on the contrary Side the Asymptote or principal Ordinate. See Fig. the 60th in *Newton*; and this is really the 62d Species. I remain

Your humble Servant,

Edmund Stone.

VII. *An Account of an Improvement on the Terrestrial Globe, by Joseph Harris, Gent.*

THE Globe is justly reckoned very useful and instructive, both as a general Map, and also for explaining the first Principles of Geography, and the spherical Doctrine of Astronomy. By this Instrument it is easy to find the Length of the Days, and their Increase and Decrease, in all Places, and at all Times of the Year. But this is not usually performed in such a manner as at the same time to explain how these *Phænomena* arise from the Motion of the Earth, which is the principal thing Beginners especially should have in View: Nor can this be remedied, at least but in few Cases, as Globes are commonly fitted up; for the Axis and the horary Circle prevent the Brass Meridian from being moveable quite round in the Horizon, which it ought to be, and so indeed prevent the Globe from being universally useful, even in the common way of considering it.

It is now about Six Years since I removed this Impediment, by placing two horary Circles under the Meridian, one at each Pole. These Circles are fixed tight between two Brass Collars placed about the Axis, but so that they may be easily turned by the Hand when the Globe is at Rest; and when the Globe is turned, they are carried round with it, the Meridian serving as an Index to cut the horary Divisions. The Globe, being thus fitted, serves readily for solving of Problems in South as well as in North Latitudes,

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as also in Places near the Equator. But the chief Advantage gained by this Alteration, is, that the Globe is now adapted for solving of Problems upon the Principles of the *Pythagorean* System, or to shew how the Vicissitudes of Days and Nights, and the Alterations of their Lengths, are really made by the Motions of the Earth. To expedite this, I had the Brass Meridian at one of the Poles divided into Months and Days, according to the Sun's Declination, reckoning from the Pole. This being done, if we bring the Day of the Month to the Horizon, and rectify the Globe according to the Time of the Day, the Horizon will represent the Circle separating Light and Darkness, and the upper Half of the Globe, the illuminated Hemisphere, the Sun being in the Zenith.

While we view the Globe in this Position, we see the Situations of all Places in the illuminated Hemisphere, with respect to the Horizon, Meridian, &c. and by observing the Angles which the Meridians, cutting any Parallels of Latitude in the Horizon, make with the Brass Meridian, we have the Semidiurnal Arches of these Parallels respectively: And at the same time (if the Sun be not in the Equator) we see why the Diurnal Arches of the Parallels continually decrease from the Neighbourhood of the elevated Pole, till we come to the opposite Part of the Horizon. If we turn the Globe Easterly round its Axis, we shall see how all Places change their Positions with respect to the general Horizon, the Meridian, &c. by the Motion of the Earth round her Axis.

It yet remains to be shewed, how the annual Motion of the Earth in her Orbit, causes the Change of the Sun's Declination: This cannot be done by the Globe simply taken, but is very well shewed by the Instruments called *Orreries*: But to these their Costliness is an Objection, not mentioning others from a want of due Proportion in the things they exhibit. I had therefore an Instrument made, which consisted only of a round Trencher of Wood, a Circle of Brass upon the Face of it, and between these three Wheels of the same Dimensions and Number of Teeth: The innermost Wheel was fixed to the Wood in the Centre, the third had its Axis come through the brass Plate, round which was a brass Circle having a Socket making an Angle with it of $66\frac{1}{2}$ Degrees; in this Socket was fixed the Axis of a little Globe, having an Horizon about it, to represent the Circle separating Light from Darkness, the Sun being supposed to be in the Middle of the Instrument. While the brass Plate is turned round through the Scale of Months and Days expressed on the under Plate, the Axis of the *Terrella* is kept all the while parallel to itself, by means of the second Wheel placed between the two above-mentioned; and so the Change of the Sun's Declination, or rather, which comes to the same Purpose, the different Position of the Equatorial Axis with respect to the Circle separating Light and Darkness, is exhibited all the while the Earth is going round in her Orbit. By placing the Axis of an ivory Ball having one half blacked, upright in the middle of the Circle which carries the *Terrella*, this little Instrument will serve to explain the *Phænomena* of the Moon's *Phases*.

Having thus learned the Cause of the Sun's Change of Declination, we may now have recourse to the larger Globe, and moving it according to the different Seasons, we may observe the *Phænomena* thence arising more distinctly.

For a graduated Meridian, I had a flexible Slip of Brass divided into Degrees, which I could fix occasionally in the two Hour Circles; and upon such another Slip I had a Scale of Months, answering to the Sun's Declination, reckoning both ways from the Equator. By means of this graduated Meridian, the Globe being rectified according to the Sun's Declination, if we gently turn it round its Axis, we may presently find the Time of the Sun's rising or setting in all Places, by observing the Hour Circle, when the several Degrees of Latitudes respectively come to the Horizon.

After the same manner, if the Globe be elevated to any particular Latitude, and the Meridian having the Scale of Months be fixed in its Place, we may soon find the Time of the Sun's rising or setting in that Latitude throughout the Year, by observing the Hour Circle when the respective Days come to the Horizon. This Method is not only useful on the Account of its being expeditious, but also because it intimates, why at the same time the Days are of different Lengths in different Latitudes, and in the same Latitude at different Times of the Year.

The Globe-makers might save us the Trouble and Expence of having these graduated Slips of Brass, by dividing some Meridian, which goes over the least Land, into Degrees, which might be marked with round Dots, and every Tenth numbered. The Scale
of

of Months might be engraved upon some other Meridian. It would be of Use likewise, if the Parallels and Meridians of every Degree between the Tropics be drawn in faint Lines, which I think might be done without obscuring the Map.

Parallel to the Horizon, and 18 Degrees below it, I had a Circle fixed for shewing the Limits of the Twilights: This is useful, as it shews at one View the State of the Twilights, and also why they do not lengthen or shorten, as the Days do. The Semi-circle of Position is a thin narrow Plate of Brass as usual, but made so that its Axis is moveable quite round the Horizon. I had also a narrow flexible Slip of Brass, which might be girt round the Globe in any Position, and so be made to represent any great Circle whatsoever: This occasional Circle may be instructive to Beginners on several Occasions.

If the principal Horizon be of Wood, or made so as to obscure the Globe below it, the Twilight Horizon had best have small Feet of a proper Length fixed so that it might stand in its proper Place upon the other, occasionally; then inverting the Position of the Globe, the same thing will be shewed as before.

The farther Use and Application of these Contrivances to different Projections of the Sphere, &c. will be obvious to those who are acquainted with these things; and without dwelling any longer upon this Subject, it may seem, that I have already said more than was needful in this Place. But the Globe being in every-body's Hands, and in reality a very useful, entertaining and instructive Instrument; I,

thought an Attempt to render it more so, would not be altogether useless, or yet unworthy the Notice of the Curious.

VIII. *A new Method of improving and perfecting Catadioptrical Telescopes, by forming the Speculums of Glass instead of Metal.*
By Caleb Smith.

THE Telescope is deservedly reckoned one of the most excellent of all the Inventions of the Moderns; such noble and useful Discoveries have been made by means of this admirable Instrument, and are still to be expected from its further Improvement, that many of the most eminent Mathematicians have employed their utmost Skill and Industry to bring it to Perfection.

The Imperfections of Telescopes are attributed to two Causes; to wit, The Unfitness of the Spherical Figure to which the Glasses are usually ground, and the different Refrangibility of the Rays of Light.

The first of these Defects only, was known to the Writers of Dioptrics, before Sir *Isaac Newton*; for which Reason (as he informs us himself, *Opt. Lect.* 1, 2.) they “ imagined, that Optical Instruments
“ might be brought to any Degree of Perfection,
“ provided they were able to communicate to the
“ Glasses, in grinding, what Geometrical Figure they
“ pleased; to which Purpose various Mechanical
“ Contrivances were thought of, whereby Glasses
“ might be ground into Hyperbolical, or even Para-
“ bolical,

“ bolical, Figures; yet nobody succeeded in the
 “ exact Description of such Figures; and had their
 “ Success been answerable to their Wishes, yet their
 “ Labour would have been lost (continues this
 “ incomparable Mathematician); for the Perfection
 “ of Telescopes is limited, not so much for want of
 “ Glasses truly figured, according to the Prescriptions
 “ of Optic Authors, (which all Men have hitherto
 “ imagined) as because that Light itself is an hetero-
 “ geneous Mixture of differently refrangible Rays;
 “ so that were a Glass so exactly figured as to collect
 “ any one sort of Rays into one Point, it could not
 “ collect those also into the same Point, which
 “ having the same Incidence upon the same Medium,
 “ are apt to suffer a different Refraction” (*Phil.*
Transf. N^o. 80.). And again, — “ Diversa diver-
 “ forum Radiorum Refrangibilitas Impedimento est,
 “ quo minus Optica, per Figuras, vel sphaericas, vel
 “ alias, perfici possint; nisi corrigi possint Errores
 “ illinc oriundi, Labor omnis in caeteris corrigendis
 “ imperite collocabitur” (*Principia, &c. Scholium*
ad finem Libri Primi).

Now, for this principal and last-mentioned Defect,
 no one, that we know of, has proposed any Remedy;
 apprehending, perhaps, the Difficulty of attaining such
 to be insuperable; inasmuch as the great Author of
 this Discovery, himself, had not shewed us any Me-
 thod whereby to correct those Errors which arise
 from this Inequality of Refraction; but rather dis-
 couraged any such Attempts, by declaring, “ that
 “ on this Account he laid aside his Glass-works,”
 (*Phil. Transf.* N^o. 80.) “ and looked upon the
 “ Improvement of Telescopes, of given Lengths,
 “ by

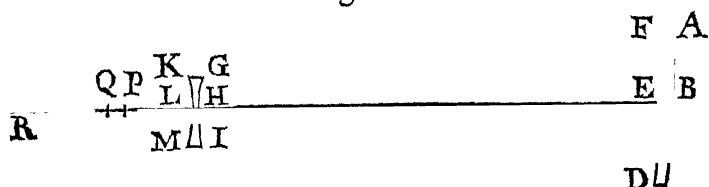
“ by Refraction, as desperate” (*Optics*, 2d Edit. p. 91.).

However, as it has been proved by incontestable Experiments, that this Dissipation of the Rays of Light, from whatever Cause it proceeds, in passing out of one Medium into another, is not accidental and irregular; but that every sort of homogeneous Rays, whether more or less refrangible, considered apart, are refracted according to some constant uniform and certain Law; and as the Removal of so great an Impediment as this of unequal Refraction in the Rays of Light, is of great Importance to the Science of Dioptrics, and absolutely necessary to its further Advancement; we have thought it worthy of a careful Examination, whether, in some Cases at least, it might not be possible for contrary Refractions so to correct each other's Inequalities, as to make their Difference regular; and if this could be conveniently effected, Sir *Isaac Newton* has acknowledged, “ there would be no farther Difficulty” (*Phil. Transf.* No. 88).

Now, upon a due Consideration of this Subject, we have found it possible, by proper Methods and Expedients, to rectify those Errors which proceed from the different Degrees of Refrangibility in different Rays, passing from one Medium into another; admitting only this well-known and established Principle, upon which we ground our Reasoning, *viz.* “ That the Sines of Refraction of Rays differently refrangible, are one to another in a given Proportion, when their Sines of Incidence are equal” (*Optics*, 2d Edit. p. 66.). And our present Design is, to shew what Advantage this will yield towards im-

improving and perfecting Catadioptrical Telescopes, by making the Speculums of Glafs, instead of Metal, in the following Manner :

Fig. 1.



Let the Figure $ABCDEF$ represent the Section of a concavo-convex Speculum, whose two Surfaces are Segments of unequal Spheres; call the Radius of the Sphere, to which the concave Side is ground, a ; and the Radius of the convex Surface, which must be quicksilver'd over, e ; let BR be the Axis of the Speculum, or a Line perpendicular to both the Surfaces; and therein let P be the principal Focus, or Point where parallel Rays of the most refrangible Kind are collected, by this Speculum; and Q the Focus, or Point of Concourse, of such Rays as are least refrangible; to wit, after they have suffer'd two Refractions, at entering into, and passing out of, the concave Surface DEF , and also one Reflection from the convex Surface ABC : If the Radius of Concavity be greater than the Radius of Convexity, as we will in the first Place suppose, then P will fall nearer the Vertex of the Speculum than the Point Q ; and the Interval QP will be the greatest Aberration, or Error, occasioned by the Separation, or unequal Refraction, of the greatest and least refrangible Rays, after their Emergence from

from the concave Surface FED . Call the common Sine of Incidence, n ; the Sine of Refraction of the least refrangible Rays out of a dense Medium into a rarer, m ; and, of the most refrangible, μ ; then, according to the known and received Laws of Refraction and Reflection, the Focal Distance of the most refrangible Rays, from the Vertex of the Speculum, (neglecting its Thickness, as of little or no Moment in the present Case) will be found

$$= \frac{nae}{(a-e)2\mu + 2ne} = PB. \quad \text{And the Quantity of the}$$

greatest Aberration, occasioned by the different Refrangibility of the most and least refrangible Rays, PQ , will be to the focal Distance just mentioned, PB , as $(a-e)(\mu-m)$ to $(a-e)m + en$; which Quantity, or Error, thus obtained, (to abbreviate the Calculation) call ε ; and now let it be required to form a Lens, if possible, which, placed at some given Point in the Axis between the Focus of the most refrangible Rays P , and the Vertex of the Speculum (as H), shall refract not only the Rays of the most refrangible Kind tending to the Point P , but also the Rays of the least refrangible Kind tending to Q , in such a Manner, that both Sorts shall concur, after such Refraction, in some other Point of the Axis R ; let HP the given Distance of the Point in the Axis H , from the Focal Point P , be called d ; and then if the Point H has been assumed, so that the said given Quantity, or Distance, d , is greater than $\frac{(\mu-n)\varepsilon}{\mu-m}$, but less than $\frac{m\varepsilon}{\mu-m}$, I say the refracting Superficies GHI , that shall perform what was required, will be part of a concave Sphere, whose

whose Radius is $= \frac{(dd + d\varepsilon) \times (\mu - m)}{m\varepsilon - (\mu - m)d}$; and HR , the

Distance of the given Point H , from R , the Point to which all the Rays will tend, after Refraction at the said concave Surface, (whose Radius being found, as

above, we call v) will be $= \frac{\mu d v}{(d + v)n - \mu d}$. Lastly,

upon the Point R thus obtained, as a Centre, with an Interval a little less than HR , describe the Circumference KLM , and the Figure $GHIMLK$ will denote the Section of a double concave Lens, which, placed at the given Point in the Axis H , (taken nevertheless within the Limits above-mentioned) will collect all Sorts of Rays proceeding from the Speculum, into one and the same Focus, or Point of the Axis, R , as was required; for the Surface GHI , which first receives those Rays, will refract the most refrangible Sort converging to the Point P , and also the least refrangible converging towards Q , so that both Sorts, after such Refraction, will concur in the Point R ; but the Rays tending to R , 'tis manifest, will suffer no Refraction at their Emergence from the Superficies KLM , because R is the Centre thereof, by Construction; which Point, R , where a perfect Image of an Object infinitely distant will be formed, we call the Focus of the Telescope, to distinguish it from the Point, P , which we have before called the Focus of the Speculum.

In this manner a Lens, (or instead thereof a triangular Prism with two of its Sides ground concave, and the third plain, if that be found as practicable) may be formed and situated, so as to correct the Errors of the Speculum arising from the different

Refrangibility of the Rays of Light. But, in order to render this kind of Telescopes absolutely perfect in their Construction, the Errors also that result from the spherical Figure, must be rectified; and with regard to this, we assert, that it is possible to assume a Point in the Axis, between the Focus of the Speculum and its Vertex, (as we have taken the Point *H*, in the following Example, see Fig. 2. p. 337.) at which, if a refracting Superficies, or Lens, be constituted, according to the Method already delivered, it will not only correct the Errors occasioned by the unequal Refraction of the Rays of Light, but also rectify such as proceed from the spherical Figure of this Speculum, to a much greater Degree of Exactness than is requisite for any Physical Purpose (meaning always the Errors of those Rays which respect the Axis). Now to find or determine this Point, affords a Problem not easy to be solved; and we recommend it, as worthy of the Consideration of Geometricians.

Seeing therefore it is possible, and we believe also practicable, to remedy the Imperfections of this kind of Speculums, (from whatsoever Cause they arise) by the Method we have here proposed; it seems to follow, that Catadioptrical Telescopes may be carried, by this means, to as great a Degree of Perfection, as they are capable of receiving; provided spherical Figures can be truly communicated, with an exquisite Polish, to Glasses of a large Aperture, and a Foil of Quicksilver made also to retain that Figure accurately, and without any Inequality; for the Object-glass or Speculum being rendered perfect, so as that all sorts of Rays, proceeding from one lucid Point in its
Axis,

Axis, shall be collected by means of the Lens exactly in another Point, its Aperture may then be extended to its furthest Limits; and that is, till the whole Pupil of the Eye (or the whole Portion of the Eye-glass to be used, when that becomes necessarily less than the Pupil) be filled with Rays proceeding from the Speculum, and flowing from one Point of the Object, but no farther; because this is a Limitation made by Nature in the Structure of the Eye itself: And in Telescopes whose Construction is such as we have now described, the largest Aperture of the Speculum that can ever be of Use, will be to the Diameter of the Pupil of the Eye, very nearly, in a *Ratio* compounded of the *Ratio's* of the Focal Length of the Speculum to the Distance of that Focus from the Lens, and of the Distance of the Lens from the Focus of the Telescope, to Unity: That is, of BP to PH , and of RH to 1; which Proportion holds, whatever be the Charge or the Power of Magnifying.

But if Inquiry be made as to the Charge most proper and convenient, that will be determined best by Experience, in these, as well as in all other sorts of Telescopes: However, on Supposition that one of a given Length has its Aperture and Charge rightly ordered and proportioned, the Rule for preserving the same Degree of Brightness and Distinctness, in all others of a like Construction, will be, to make the Apertures, and magnifying Powers, directly as the Focal Lengths of the Speculums; which shews the vast Advantage and Perfection of these Telescopes, above the common reflecting ones; where, according to Sir *Isaac Newton's* Rule, the Apertures, and

Powers of Magnifying, must be as the Biquadrate Roots of the Cubes of their Lengths (See his *Optics*, 2d Edition, p. 97.).

It is likewise a considerable Advantage in this Construction, that the Reflection from the concave Side of the Speculum will do no sensible Prejudice; because the Image of any Object made thereby, is removed to so vast a Distance from the principal Image, formed by the convex Surface, as to create no manner of Confusion or Disturbance in the Vision; which necessarily happens, in some Degree, from the Vicinity of those Images, when the Glass is ground concave on one Side, and as much convex on the other; according to the Method propounded by Sir *Isaac Newton*, in his most excellent Book of *Optics*.

It may be imagined, perhaps, at first View, that (if our Reasoning is just) the Errors of refracting Telescopes, occasioned by the different Refrangibility of Light, may be corrected by a like Artifice: But the Aberration of the Rays from the principal Focus is there so great, and bears so considerable a Proportion to the Focal Length of the Telescope, that the Error cannot be rectified by the Interposition of any Lens, until the Rays are, by a contrary Refraction, collected again at an infinite Distance, which renders this Expedient quite useless; however, there is no need to despair of accomplishing even this, by other Methods: And, by the way, we may observe, if it were worth while to seek a Remedy for the Errors occasioned by the spherical Figure of the Object-glass only, in Dioptrical Telescopes; that might be obtained by the proper Application of a
suitable

suitable Lens, between the Focus and the Vertex of the Object glass; which is much more easy and practicable, than the grinding of Glasses to Hyperbolic or Elliptical Figures.

For a further Illustration of what is gone before, it may be proper to exhibit the several Parts and Proportions of a Telescope in Numbers computed according to the Theorems already delivered; and in Practice we judge it will be most convenient, that the *Radii* of the Spheres to which the concave and convex Sides of the Speculum are ground, be nearly in the Ratio of 6 to 5; as in the following Example; where (see Fig. 2. p. 337.)

ABCDEF, represents the great Speculum of Glass, ground concave on one Side, and convex on the other; quicksilver'd over the convex Side, and of an equal Thickness all round its Circumference.

The *Radius* of Concavity $= a = 48$ Inches.

The *Radius* of Convexity $= e = 40$ Inches.

Then putting n , the Sine of Incidence $= 100$; m , the Sign of Refraction of the least refrangible Rays, out of Glass into Air, $= 154$; and μ , the Sine of Refraction of the most refrangible Rays, $= 156$; as Sir *Isaac Newton* found them by Experiments; we shall have,

PB, the Focal Length of the Speculum with regard to the most refrangible Rays $= 18.2926$ \dagger , which will be somewhat increased by the Thickness of the Glass, when that is considerable.

PQ, the greatest Aberration of the Rays, occasioned by their different Degrees of Refrangibility, $= .05594$ \dagger , which Quantity, in Practice, should be

be a very little augmented, rather than otherwise ;
wherefore we put it here $= .056 = \varepsilon$.

The *Radius* of the concave Surface of the Lens,
turn'd towards the Speculum, *viz.* of *GHI*, $= 0$
 $= 2.8$ Inches.

The *Radius* of the concave Surface of the Lens,
turn'd from the Speculum, *viz.* of *KLM*, $= 6.7$
Inches.

The Thickness of the Lens at the Vertex *LH* $= \frac{1}{10}$
of an Inch.

The Aperture of the Lens must be about $\frac{1}{2}$ of the
Aperture of the Speculum.

HP, the Distance of the Focal Point *P* from the
Point *H*, where the abovesaid Lens is to be placed,
so as to correct the Errors arising from the different
Refrangibility of the Rays, and also the Errors of
the spherical Figure, $= 2.\frac{24}{3}$ Inches.

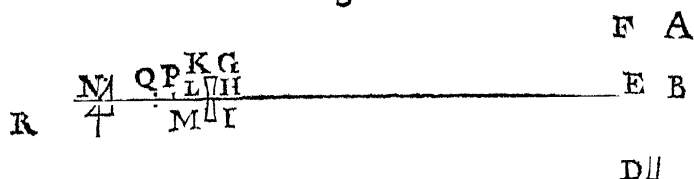
HR, the Distance of *H* the Vertex of the Lens from
R the Focus of the Telescope, $= 6.8$ Inches.

And if we suppose the Diameter of the Pupil of the
Eye to be $\frac{1}{4}$ of an Inch, (though it has not one
certain Measure) then the Diameter of the greatest
Aperture of the Speculum, that can ever be of Use,
will be $6\frac{2}{3}$ Inches, nearly.

The small plano-convex Eye-glass *O* must always
have one common Focus with the Telescope, to
wit, the Point *R* translated to *r*, by Reflection from
the Base of the Prism *N*; for which Reason it must
retain, at all times, an equal and invariable Distance
from the Lens *GHIKLM*; which Distance will be
the Focal Length of the said Eye-Glass more *HR*
($= HN + Nr$) the Distance of the Lens from the
Focus of the Telescope *R*.

The

Fig. 2.



The Form and Position of the Prism *N*, and the Contrivance of the other Parts necessary, will be much the same as in the *Newtonian* Telescope.

If the Focal Length of the Eye-glass be $\frac{1}{4}$ of an Inch, the Telescope will magnify about 200 times.

This Telescope may be contrived in the *Gregorian* way, by using, instead of a Lens and Prism, a small Speculum spherically concave on one Side, and convex on the other; but we think it not worth while to attempt this Construction, as an Investigation of the Proportion between the two Surfaces necessary, in this small Speculum, to unite the Rays proceeding from the great one, into one Point, would be intricate, and the Practice also very difficult; by reason that a little Inaccuracy will, in this Case, occasion Errors much more considerable than a like Imperfection in the refracting Lens.

We have hitherto supposed the *Radius* of the Concavity greater than that of the Convexity; as being most convenient and useful, on several Accounts, in forming this kind of Telescopes; however, it may be proper to remark, that the same Method may be used for correcting the Errors of the Speculum, when the *Radius* of its Concavity is less than that of the Convexity; only the refracting Superficies of the Lens, placed between its Vertex and Focus, will be

how this Error may be rectified by one or more Glasses, placed in the Axis, at a Distance farther from the Vertex than the Focal Point *P*; but the former Speculum is so much preferable to this, for the constructing of Telescopes, that we think it not worth while to prosecute this Matter farther. To conclude this Essay;

Whoever shall think fit to put the Method here proposed in Execution, we dare venture (from a Trial that has been made) to assure him of Success; provided the same Diligence, Care, and Accuracy, be applied, in choosing, figuring, polishing and foiling, the Glass, that has of late been employed for the forming Speculums of Metal; and let none be discouraged, though the first and second Attempt should fail; for that must be expected, if the ordinary way of grinding and polishing be used: Greater Exactness is here required, than is usually thought sufficient for the Object-glasses of refracting Telescopes: Let it be also considered how many Essays, for a long Term of Years, were made by Mr. *Gregory*, Sir *Isaac Newton*, and others, to reduce their Constructions of the reflecting Telescope into Practice, without answering, in any tolerable Degree, what their Theories promised: The Workmen they employed were chiefly Optical Instrument-makers, and had it been left to such Persons only to perform by themselves, we have reason to think, that it would have been pronounced impracticable to this Day, to make a reflecting Telescope that should equal or excel refracting ones of Ten times its Length; though we now see, that most of these Artificers are

capable of making them to such a Degree of Perfection as was formerly despaired of.

April 5. 1739.

IX. *Extract of a Letter from the Hon^{ble} Henry Temple, Esq; to his Father the Right Hon^{ble} the Lord Viscount Palmerston, concerning an Earthquake at Naples; communicated to the Royal Society by Claudius Amyand, Esq; F.R.S. and Sergeant Surgeon to His MAJESTY.*

Naples, Dec. 12. N. S. 1732.

THEY tell me, the last Earthquake here has made a great Crack in the Side of Mount *Vesuvius*, above 30 Yards long. I am not sure if this be true or not, though I think it very possible; but I made another Observation upon it, which I think much more extraordinary; which is, that the second Shock, which was a very slight one, had a great Effect upon the Nerves: I and all the Company where I was, as soon as the Shock was over, were seized with a Shaking, just as if we all had the Palsy, our Teeth chattering in our Heads to such a degree, that we could hardly speak; and I find, that half the Town felt the same Effect from it. It would be natural to imagine, that this Shaking was caused by the Fright, but it is easy to prove the contrary; because, in the first place, the first Shock, which was much more terrifying, had not that Effect:

Secondly,

Secondly, many People who were not sensible of the Earthquake, found themselves seized in the same Manner: Thirdly, Mr.—who used to be troubled with convulsive Fits, and had got quite cured of them here, was immediately seized with them again, after the Earthquake; and, Fourthly, every body, more or less, complained of Head-achs for some Days after.

X. *A Letter from Mr. Timothy Sheldrake to Sir Hans Sloane, Bart. Pr. R. S. &c. concerning a Monstrous Child born of a Woman under Sentence of Transportation.*

SIR,

Norwich, Jan. 8. 1734-5.

I Herewith send you both a Draught and Description of a monstrous Birth, which I believe the ROYAL SOCIETY have had as yet no Account of; which gives me Hopes, that what I here send will prove the more acceptable to you.

Elizabeth Spencer, being tried at our Assizes for the City and County of *Norwich*, for Shop-lifting, and being found guilty of the Crime, received Sentence for Transportation; for respiting of which Sentence she pleaded her Belly, which Plea, as she was a married Woman, appearing what was very probable, she was favour'd by the Mayor and the other Magistrates, by being allowed the full Time that she said she had to go; at the Expiration of which she was delivered of a Child, which I saw a few Hours after

it was born, and was exactly, in every Part, according to the following Account, and as I have here delineated it [See TAB. II. Fig. 2.]. The Head had a Rising on the Top of it, and the Nose was as if one Nose was on the Top of another, but only two Nostrils, and those at the Bottom of the lower Nose. The Arms were without the Elbow-Joint; the two Bones, which make the lower Joint of the Arm, in common, were in this extended to the Shoulder. Just under the Ribs, and above the Hips, was a deep Place, as if a Cord had been tied very streight, so as to sink down below the Reach of the Eye: This girding-in of the Body, I believe might go almost round: I did not turn it, to see whether it did or not, but it was continued as far about the Body as I could see, without turning it. By this girding-in of the Body, the lower Part of it was almost round, it being without either Legs or Thighs; but had two Feet joined unto the lower Part of the Body, the Heels inward, the Toes (of which it had not the full Number) pointing towards the Sides, as is described in the Drawing here inclosed. As to Sex, this Creature was a Female, and born alive. It was the Opinion of the Women about her, that the Midwife had injured the Head in the Birth, by which the Rising in the Head was produced; and this surprising Creature that was born alive, was thereby soon deprived thereof. This Woman, who had been the Mother of several Children, before this strange Production, and all in perfect Form, was by some free-speaking Persons charged with having been guilty of some Practices both unnatural and unlawful, which she very positively always denied; and said that she knew nothing that
could

could give any Change to the natural Form of this Creature, but the strange Apprehensions that her Sentence had put her under, from the uncommon Creatures the Country to which she was sentenced might bring in her Sight. These odd Ideas that she had formed to herself, was all and the only thing, that had occasioned so great a Change from the natural Form the Child might otherwise have had, as she often asserted. I am,

S I R,

Your very humble Servant,

Tim. Sheldrake.

XI. *A Paper concerning the Mola SALU. or Sun-fish, and a Glue made of it ; communicated by the Rev. Mr. William Barlow to the President of the Royal Society.*

Stoke-Dock near Plymouth, Devon,

June 29. 1734.

THERE was brought to this Place, struck the Day before in our River, a *Sun-fish* weighing about 500 Pound Weight. The Form of it nearly answers that given by Mr. *Willoughby*, except that the Tail of this was scollop'd.

This Fish differed very much in one thing from that described by Mr. *Willoughby*, whose Flesh, he says, was very soft : On the contrary, the Flesh of this was hard and firm, rather a gristly Substance than soft Flesh.

A Gentleman of my Acquaintance, Commander of a Vessel, tells me, his People took a *Sun-fish*, South of *Newfoundland*, which, by his Description, was considerably larger than that brought hither. They made no Use of the Flesh; but he remembers it was a gristly Substance, hard and firm.

A Piece of the Flesh boiled, to try how it would look and taste, to our Surprize, was all turned into a Jelly. Being soft and tender, it could not be taken out of the Saucepan with a Fork, but only with a Spoon; in Colour and Consistence nearly resembling boiled Starch when cold. It had little or nothing of the Fishy, but a grateful and pleasant Taste.

By the sticking together of my Lips, and from what I observed by touching it with my Fingers, I took Notice, that this boiled Flesh was clammy and glutinous; which brought to my Mind, that what the Antients made use of to serve the Purposes of Glue, was made from Fish. I then tried it upon Paper and Leather, and found it to answer the Use of Paste very well: And it was owing in part to Neglect, and partly to Accident, that it was not also tried upon Wood.

From this Discovery of the glutinous Nature of the Flesh of the *Sun-fish*, I would recommend it to those who have Opportunity to make farther Experiments upon it; and probably something useful, or curious at least, may be a satisfactory Reward for the Trouble they shall give themselves on that Account.

From the Descriptions given us of the *Ichthyocolla* by *Dioscorides* and *Pliny*, the Glue-fish seems not
to

to be the same as our *Sun-fish*. Whether the Fish from which our Isinglass is made, be the same as the *Ichthyocolla* of the forementioned Authors, as the Name usually given to it seems to import, I cannot tell: But neither the *Ichthyocolla* of *Rondeletius* or *Bellonius*, nor the *Huso* taken in the *Danube*, from the Bladder of which Fish-glue is made, can, by the Descriptions given of them, be the same as the *Sun-fish*.

XII. *An Account of the Discovery of the Remains of a City under-ground, near Naples; communicated to the ROYAL SOCIETY by William Sloane, Esq; F.R.S.*

T *Resina*, about four Miles from *Naples*, under the Mountain, within half a Mile of the Seaside, there is a Well in a poor Man's Yard, down which about 30 Yards there is a Hole, which some People have the Curiosity to creep into, and may afterwards creep a good way under-ground, and with Lights find Foundations of Houses and Streets, which, by some it is said, was in the Time of the *Romans* a City called *Aretina*, others say *Port Hercules*, where the *Romans* usually embarked from for *Africa*. I have seen the Well, which is deep, and a good Depth of Water at the Bottom, that I never cared to venture down, being heavy, and the Ropes bad. This City, it is thought, was overwhelmed by an
Eruption

Eruption of the Mountain *Vesuvius*, not sunk by Earthquakes, as were *Cuma*, *Baia*, *Trepergola*, &c.

Naples, March 7. 1731-2.

Signed,

William Hammond.

SIR,

In pursuance to your Desire, the above Account is transmitted me by my Partner, about the City you mentioned under-ground near *Naples*.

I am very respectfully,

SIR,

Your most humble Servant,

John Green.

XIII. *An Account of a Meteor seen in the Air in the Day-time, on Dec. 8. 1733; communicated by Mr. Crocker to Sir Hans Sloane, Bart. Pr. R. S. &c.*

SIR, *Fleet, Dorsetshire, Dec. 23. 1733.*

ON *Saturday* the 8th of this Instant, the Sun shining bright, the Weather warm, and Wind at South-East, some small Clouds passing, I saw something (between Eleven and Twelve) in the Sky, which resembled a Boy's Paper Kite, which appeared towards the North, and soon vanished from my Sight, being intercepted by the Trees which were near the Valley where I was standing. The Colour
of

of it was of a pale Brightness, like that of burnished or new-washed Silver. It darted out of my Sight with a seeming Coruscation, like that of Star-shooting in the Night; but had a Body much larger, and a Train much longer, than any thing of that Kind I had ever seen before. At my coming home, one *Brown* assured me, he had seen the same thing, for the Continuance of a Minute; and that the Body and Train appeared to him to be about twenty Foot long, and seemed to him to fall to the Ground somewhere about the Kennel-garden, whither I accompanied him in Expectation of finding some of those Jellies which are supposed to owe their Beings to such Meteors: But we might have searched long enough, as I understood the next Day, when Mr. *Edgcombe* informed me, that he and another Gentleman had seen the same Appearance at the same time about fifteen Miles from us, steering the same Course from East to the West, and vanished from them between *Walthamton* and *Oakhampton*: They gave the same Account of its Figure, Length and Colour.

XIV. *An Account of a Luminous Appearance in the Sky, seen at London on Thursday March 13. 1734-5. by John Bevis, M.D.*

AS I was observing *Mars* near a small fixt Star, then in the West, on the Top of my House in *Buckingham-street*, about five Minutes after Eight, equal Time; happening to turn my Face Southward, I was surpris'd with an uncommon bright Glade of
Y y
Light.

Light. It was strait, about $2\frac{1}{2}$ Degrees broad, and 110, or 120 Degrees long, ill declined at either End, but pretty well at the Sides, that is, much as the common Rainbow, or one of those Pyramids which are used to dart up from the Horizon in an *Aurora Borealis*, which Light it resembled in all respects, except in its Place and Position, and that this was steady, and altogether without that tremulous kind of Motion, which usually accompanies that. Besides *Saturn*, *Mars*, *Venus*, and the fixt Stars, there was then no other Light in the Sky, nor the least Cloud, nor any of that horizontal Blackness which we see Northward in the *Aurora*. The Stars were as discernible through it, as if nothing had been there. A Gentleman who was with me, fancied it to be the Tail of a Comet; but as neither he nor myself had ever seen one, I gave but little Heed to that Conjecture: However, I carefully directed a 17 Foot Glass to all Parts of its western Extremity, but could discern nothing like a *Nucleus*. When I first saw it, it extended itself from about the Mid-way between *Aldebaran*, and *Orion's* Left Shoulder, through *Gemini* a little under β , and so on through *Cancer* and *Leo*, just above *Cauda Leonis*, till it arrived between *Vindematrix* and *Coma Berenices*, where it ended very dilutely. In about half an Hour it grew dim about the Middle, where in a short time it separated in two, or rather became quite dark there; but then methought the disjointed Parts were more luminous than before; but they too in a little while after grew dimmer, and shortened away, on to their remote Extremities, which remained visible the longest; the Western one about Nine o'Clock, the

Time

Time of its Extinction, being near *Orien's* Right Shoulder, and the other near the Left Knee of *Boötes*; so that this Meteor seems pretty nearly to have accompanied the Earth in its diurnal Motion, and to have had little or no Motion besides. I have looked for this Light since, but could find nothing like it.

The Day was exceeding fine, and by my Journal I find, that,

At Noon, the Barometer was	29.98.
Thermometer	57.
Wind	East.
Decl. of the Needle	14° 10.
At 10 at Night, Barometer	29.86.
Thermometer	57.5.
Decl. of the Needle	13° 50'.

XV. *An Account of the Case of a Calculus making its Way through an old Cicatrix in the Perinæum, by David Hartley, M. A. F. R. S.*

Jan. 12. 1740.

William Farman, of the Parish of *Bayton* in *Suffolk*, was cut for the Stone about 15 Years ago, and a large Stone taken from him.

The said *William Farman* says, that he continued easy for about four Years after he was cut; that the Wound was quite healed up, and that he made Water in the natural Way, without any Leakage at the Wound.

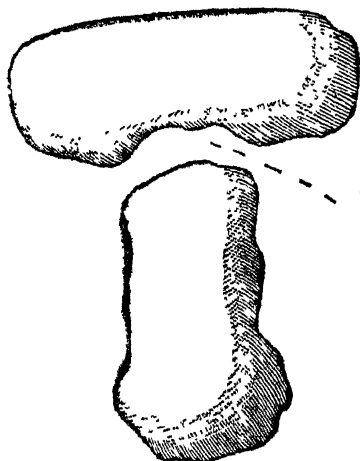
In *July* last, he says, he felt great Pain at the Place where he was cut, and that it was much swelled.

It looked black, and a little Hole broke open there, out of which the Water came ; and a Stone appearing, the Hole grew wider by the Force of the Water, and his frequently touching it, till at last the Stone came away whole. It was broken afterwards by a Fall.

As soon as the Stone was come away he says that he grew easy, and the Swelling abated. The Wound is now reduced to a small Compass, and the Water still comes away through the Wound, and but very little Water comes out the natural Way.

William Jarman is about 30 Years of Age. He says, that the great End of the Stone came away first, which he suffered to lie at the Mouth of the Wound near a Fortnight, but he applied to no Surgeon.

An Addition by the Publisher to the foregoing Case.



There they articulated
or rubbed against each
other, while in the
Bladder ; one having a
round Head, the other
a Cavity.

Figures of Stones which made their Way through the *Perinæum* of
a Man at *Leyden*, *Anno* 1724. seen there by *C. Mortimer*.

XVI. *An Account of a Stone, or Calculus, making its Way out through the Scrotum; communicated by Mr. John Sisley, Surgeon, to Sir Hans Sloane, Bart. Pr. R. S. &c.*

ONE Robert Swann, of East-Malling, Kent, a hard working Man in the Woods, sent for me one Day to see him. When I came to him, I found him with a large Swelling on his *Testicles*; on the upper Part of the *Scrotum*, I found a small Hole or two, and he told me, his Urine oufed out sometimes. I passed the Probe in, and found a hard Substance, which seemed to be large: I told him, he had a large Stone lodged there, at which the poor Man was much surpris'd. I told him, I would make Incision and take it out; he refused to be cut. I dilated it in another Manner, made the Orifice pretty large: The Swelling of his *Testicles* abated, he goes to work, as usual; about a Week's time after, coming home at Night with a large Bundle of Wood at his Back, found himself more in Pain than ordinary; as soon as he got home, complain'd to his Wife, and told her he was very much in Pain, went to-bed, desired me to be sent for immediately; but before I could get to him, the Stone forced its Way out; and as soon as I came to him, the poor Man seemed much rejoic'd, and told me, (as he expressed himself) the *Swan* had laid an Egg: Its Weight at first was 3v and 3ij , now almost four Ounces and three Quarters. This Man lived about seven Years after this, in a good State of Health, and lived to the Age of Threescore

or

or upwards. He told me, he believed the Stone had been growing there for near thirty Years; but never apprehended it to be a Stone, but used to complain of a Weight, as if it were half a Pound, carried between his Legs.

John Sisley,
Surgeon and Apothecary,
Town-Malling, Kent.

XVII. *A Letter from Mr. Moreton Gilks, F. R. S. to Dr. Mortimer, Sec. R. S. giving some Account of the Petrefactions near Matlock Baths in Derbyshire; with his Conjectures concerning Petrefaction in General.*

S I R,

IN the mountainous Part of *Derbyshire*, about *Cromford*, is a Valley of at least a Mile and half long, walled on each Side with high craggy Rocks; the East Side clifffy, the West more reclining, but extremely rough and difficult of Ascent; being composed of large loose Pieces of the Lime-stone Rock, of five, ten, or twenty Ton Weight; that seem at some Distance of Time to have broken off from the Top of the Cliffs, and fallen down into the Valleys.—At the Bottom of the Valley, which seems to be a great gaping Fissure of the Rock, runs the River *Derwent* harshly along its rocky Bottom. About the Middle of the Valley, at near 50 Foot perpendicular Height from the River, issue forth several
Ri-

Rivulets of a luke-warm Water, that pour themselves into the *Derwent* below. Some of this Water, being collected in a Reservoir, on account of its agreeable Warmth, hath of late Years been much used for bathing, and is called *Matlock Bath*. Now for about the Compass of 500 or 600 Yards, near to where this Water gushes out, the Stone appears of a very different Texture and Complexion; and proves, upon Examination, to be a perfect Incrustation, formed upon the original Rock; composing a facitious Stone, of Earth, Vegetables, &c. of various Kinds, such as usually grow in rocky Places, as Polypody, Tricomanes, and other Species of the capillary Tribe, Mosses, Brambles, Ivy, Hazle, &c.—There are several large Grotto's at about 15 Foot above the Level of the River, lined most curiously with the *Stalactitæ*, *Lapides Stillatitii*, &c. Some of them nearly resemble large Bunches of Grapes, and other Clusters of Fruit, very beautiful to look upon. Specimens of most of them I think I have sent.—I found upon Examination, that the farther you penetrate into this Mountain, the closer and more compact the Stone appears; the Interstices in the petrified Matter being at the Depth of 15 or 16 Foot, almost filled up, and nearly as solid as the Lime-stone, of which the original Rock is composed; and even within four or five Foot of the Surface, though very open and porous; yet is it so hard as to be used in the Building about the Bath; and I imagine it may be equally durable, though easier to work with the Saw, than the close Lime-stone.

The Mountain in several Places jets out almost over the Brink of the River; under these Protuberances
are

are the Grotto's, very dangerous and difficult to get at. It was here the Specimens I send you were collected †, but it is impossible to give you an Idea of the natural Beauty of the Place. The Frost-work, and incrusted Plants, are some of them so very delicate and tender, as to make it impracticable to bring them away with half their Beauty, by the most careful Conveyance. In one Place there is an Ivy creeping along the Rock, part of it intirely petrified, another part only incrusted, and a third still vegetating. In another Place is a Hazle-tree, the Root whereof composes a Part of this petrified Mountain, the Branches some petrified, and some tenderly incrusted. As these are changed, others spring up, and in Time will undergo the same Fate. In short, nothing in Nature can give a more clear Idea, or more beautiful Representation, of the whole Business of Petrefaction, than a curious Observer will see, and frame in his Mind from this Mountain. He will see, that not only the Water, as it distils out of the Rocks, is capable of incrusting and petrifying the Bodies it meets with in its Passage, but that even the Steams and Exhalations*, being highly saturated with these mineral Particles, will work the same Effect; as is evident in the Place under Consideration, and will generally best account for the Supply of petrifying Matter, brought to fill up the Vacuities that are left by the Decay and Waste of Vegetables incrusted over; and which, he will see, are in Course of Time constantly filled therewith. For although the Water of some

† They are deposited in the *Museum* of the ROYAL SOCIETY.

* Vide *Woodward's Natural History*, p. 136. 209.

Springs may be so loaded with mineral Matter, as, perhaps by penetrating the Pores of Wood and other lax Bodies, to increase greatly their specific Gravities; yet surely it is contrary to the Laws of Matter, and absurd to say, there is any hidden Property in such Waters capable of changing the Parts of one Body into another Body specifically different. It may in time, no doubt, lose its Texture and Coherency, by the Admittance of heterogeneous Particles of different Attractions; but the Cause of Coherency in the Parts of the original Body must intirely cease, and be dissolved, before it can be said to become a Part of any other Body whatever. Afterwards, indeed, the Space that was possessed by the Parts of the original Body, may be supplied by those of the new one, so as to make in time a uniform Stone in the Shape of the original Plant: But if this petrified Plant be still kept in the Place where the same petrifying Quality continues to act upon it, it will lose even that Shape, and become a Part of the Body it is contiguous to; and so a great many of these petrified Plants, and other Bodies united together, will compose large Masses and whole *Strata* of Stone. This is clearly the Case in the Instance now before us, and perhaps it might be carried so far as to strengthen our Conception about the general Formation of the *Strata* of Lime-stone or Marble; that appearing to be every-where, (notwithstanding Dr. *Woodward* dispatches them much more expeditiously *) but especially in the *Peak of Derbyshire*, such a Petrefaction as I

* *Woodward's* Natural History, Part II Conf. 4.

have been describing, quite finished. I could urge many Reasons for my Supposition, but I will not trouble you with them here, the Compass of this Letter not permitting me; nor do I know how far such Conjectures are capable of being used, with regard to the received Opinion of the World's Age; but if we had as good Authority to suppose it 60,000 Years old, as we have 6000, it would be worth the while to trace the Origin and Source of these petri-fying Exhalations a little deeper than seems to have been done by Dr. *Woodward*; and might either perfect his History, or produce a more rational System of the Earth than has yet appeared.

You will find, amongst the things I send, some Land-coral found in a Lime-pit, where is a great Quantity of it, between Two *Strata* of Lime-stone of at least Three Foot thick. You will find also some few Pieces of *Pseudo-sapphirus*, and other kinds of Spar; they are such as I picked out of the Fissures of the Rocks I have been describing. There is a vast Variety of these things in the *Peak*, much greater than hath been taken Notice of by any one; as I shall convince the ROYAL SOCIETY, when I am able to present them with a complete Collection of *Derbyshire* Fossils, in which I have already made some Progress: Who am,

S I R,

Burton, Nov. 26. 1735.

Your most humble Servant,

Moreton Gilks.

XVIII. *Part of a Letter from the Abbe Pluche to Dr. Mortimer, Sec. R. S. concerning the Smut of Corn. Translated from the French by T. S. M. D. F. R. S.*

S I R, Paris, Oct. 24. 1736. N. S.

I Have lately passed some Months in the Country, where I have had the Satisfaction to read in the great Book (Nature), which far exceeds all our Libraries; and I made several small Observations, among which are the following:

1. Having with the Assistance of the Microscope viewed the *Smut of Corn*, I observed the Stalks were all spotted and pricked with small Burnings: Now as the *Smut* happens after a fine Rain followed by a bright Sun-shine, the Cause of this Evil is, that the Focus of those very small Drops is just near them, and on the Stalk that supports them: Wherefore the Sun's Rays, collected in this Point, must there burn; which dries up the Stalk, and prevents the Ear from graining.

The second Remark is on the Corn that grows up into Ears, the Grains of which are for the most part full of Meal quite black. With the Microscope I saw, all round or above these black Grains, small long Bodies, rolled up, and having each a Pedicle; which I found to be the Flowers, that could not reach their due Form, or come forth and ripen; so that the Grain, being deprived of this Help, could not develop its Germ, and produced only a black Meal, for want of the unfolding of certain Vessels.

The third Remark is, the Reason that invites *Thrushes* or *Starlings* under the Legs of black Cattle grazing in a Pasture. Not being able to get near them, I observed them at a Distance with a good Glass. I saw all these Birds thrust their Head and half their Body down into the Grass, in such manner that their Tails remained erect in the Air, as that of a *Duck* upon diving; which makes me think, that those Birds seek after Worms in the Earth; and that they gather about the Cattle, because as they are large Animals, upon trampling on the Ground, they oblige such Worms to come forth, as happen to be press'd under the Weight of their Hoofs.—I shall be glad of every Opportunity of convincing you how much I respect you, and am,

*Your most humble,
and most obedient Servant,*

Pluche.

XIX. *A Letter from John Bartram, M. D. to Peter Collinson, F. R. S. concerning a Cluster of small Teeth observed by him at the Root of each Fang or great Tooth in the Head of a Rattle-Snake, upon dissecting it.*

Mr. Collinson, Philadelphia, July 17. 1734.
NEAR *German-town*, about six Miles from this City, we found a *Rattle-snake*, which is now become a Rarity so near our Settlements. I took it home,

home, and dissected it: In the Head I met with what has not been observed before by any, that I can remember — that is, a Cluster of Teeth on each Side the upper Jaw, at the Root of the great Fangs, through which the Poison is ejected. — I observed, in the same Case, that the two main Teeth were sheathed in, lay four others at the Root of each Tooth, in a Cluster together, of the same Shape and Figure with the great ones — and I am apt to think for the same Use and Purposes, if by Accident the main Teeth happen to be broken — as was the Fellow to this that I send you. — May not these Cluster of Teeth be placed to supply such a Defect successively — for the Support and Defence of this Creature?

I am not certain whether this is an uncommon Case; perhaps others have not dissected the Head of this Animal with the Care that I have done. —

I am yours,

John Bartram.

XX. *Notices of some Meteors observed at Philadelphia in North-America by Joseph Breintnall, extracted out of a Letter from him to Peter Collinson, F. R. S.*

Philadelphia, May 9. 1738.

— THE remarkable *Aurora Borealis*, that was seen in *Europe* the Beginning of last *December*, was not seen here.

But

But we had a visible *Aurora Borealis* the 29th of *December* 1736. The Day was clear, with a brisk cold Wind North-west, the Evening calm and serene, and about Seven we had a red *Aurora Borealis*.

On the 19th of *November* 1737. about Sun-set, many People in this Town saw a fiery *Meteor* in the Air, large and bright; it seemed in the *Zenith*, and so it seemed to them some Miles from Town; it was observed to be higher than the lower Clouds.

On the 7th of *December* 1737. a Minute or Two before Eleven at Night, we had two Shocks of an Earthquake, greater than ever felt here before. The second Evening after, and for several Evenings in this Month, a red Vapour appeared to the Southward and South-westward, like the *Aurora Borealis*.

XXI. *A Description of the Cave of Kilcorny in the Barony of Burren in Ireland, contained in a Letter from Mr. Charles Lucas, Apothecary at Dublin, to Sir Hans Sloane, Bart. Pr. R. S. &c.*

S I R,

BEFORE I give a particular Description of this Cave, it may be proper to give a short Sketch of that Part of the Country in which it is situate, being mostly neglected, or deemed unworthy of the Notice or Observation of any Historian hitherto.

That Part of *Ireland* called *Burren*, is a small Barony in the North-west Part of the County of
Clare,

Clare, and bounded on the North Side by the Bay of *Galway*. It is from one End to the other a Continuation of very high, rocky, Lime stone Hills, there being little or no plain Land throughout the Whole. It is that Part of which it is reported, that *Oliver Cromwell* said, (when he came to storm a few Castles in it) That he could neither see Water enough to drown a Man, Wood enough to hang a Man, or Earth enough to bury a Man in: Notwithstanding it is most fertile, and produces immense Quantities of Juniper, and some Yew; besides great Variety of the Capillary Herbs, *Virga Aurea*, *Verbena*, and some other common Plants, I have found the *Teucrium Alpinum magno flore*, of *Caspar Bauhin*, and a large shrubby *Cinquefoil*, answering the Description Mr. *Morison* gives, in his Second Volume of *Hist. Oxon.* of his *Pentaphylloides rectum fruticosum Eboracense*.

The Inhabitants are but few, and they mostly poor Cottagers, whose chief Stock is a Parcel of Goats. They are courteous and good-natured to Strangers, though very wild and unpolished; weak, blind, superstitious Zealots to the Church of *Rome*, and (like some more polite People in the World) led and enslaved by a Set of mean, ignorant and illiterate Priests.

The Place where this Cave lies, is called *Kilcorny*: It is a pretty low Valley, in Comparison to the Hills that surround it: The Entrance is into the East End of it, (for it lies East and West) about Midway. There are the Ruins of an old Church, and, a little Westward of it, an even Plain of about an Acre of Ground; on the North Side of which, under a steep rugged Cliff, lies the Cave.

The

The Mouth of it is level with the Plain, about Three Feet Diameter: It has been much larger, but was blocked up with Lime and Stone, which plainly appears still, but to what Purpose is not known. Some conjecture it was an Attempt to restrain the great Flux of Water; but the fabulous Natives, who tell numberless romantic Tales of it, say, it is a Passage to the *Antipodes*; and that a Stud of fine Horses have been seen coming out of it very often, to eat the Corn sown in the Valley: They further add, that many Stratagems have been tried to catch some of them; but, with the Loss of some Mens Lives, they could catch but one Stone-horse, the Breed of which, being very valuable, they say is kept to this Day by *O Loghlen*, which with them is a kind of titular King that they pay great Respect to. But to return to the Cave:

When you pass this narrow Entrance, it grows much wider and loftier. The Floor is a pretty even Rock, from Two to Four or Five Yards broad: The Sides and Top are rugged and unequal, from Six to Twelve or Fourteen Feet high.

About Forty Yards from the Door, there is a pretty deep Pit, Seven or Eight Yards over; but, when passed, the Floor is plain and even, as before, for about Two hundred Yards, which is the farthest that any one known has ventured into it: For my part, I did not pass this Pit, but have seen several that did, whose Veracity I can depend upon. Most People that have gone into it, went by a Thread or Clue; others have carried a Bundle of Straw, and dropped it by the Way, to guide their Return; which seems altogether unnecessary, there being no Windings or Chambers throughout

throughout of any Extent. It is all over, even in the Depth of Winter, as dry as any Place of the kind under-ground can be; and what seems very prodigious, is, that it often pours forth such a Deluge as covers the adjacent Plain, sometimes with above twenty Feet Depth of Water.

The Times of its overflowing are uncertain and irregular; sometimes it does not happen above once in a Year or two, but most commonly Three or Four times a Year: It is sometimes observed to succeed great Rains and Storms, though it often happens without either.

The neighbouring Inhabitants are alarmed at its Approach, by a great Noise, as of many falling Waters at a Distance; which continues for some Hours before, and generally all the time of the Flood.

The Water comes forth with extreme Rapidity from the Mouth of the Cave, and likewise from some smaller Holes in the low Ground, attended with a surprising Noise: It flows for a Day or two, and always returns into the same Cave, and partly into the small Holes, from whence it was observed to come before, but with a more slow and tardy Course: The Water is of a putrid Quality, like stagnated Pond-water, insipid as Spring-water. It always leaves a filthy muddy Scum upon the Ground it covered, which greatly enriches the Soil.

It has been known sometimes (though rarely) to overflow and ebb in six or eight Hours time, but in a much less Quantity.

There is neither River or Lake any-where in that Part of the Country, and it is above Six Miles from the Sea. There are very near it several much lower

Valleys, in which there is no Appearance of Water, unless a little Rain-water collected in a Pit, in the Fissure of a Rock, or the like.

If there be any Queries about further Circumstances relating to it, any way material to be asked, I shall be always ready to answer them, having spent a good deal of Time upon the Spot, examining of it myself; so that I can aver this whole Narrative for Truth, from my own actual Observations.

I thought it a pity so remarkable and wonderful a *Phænomenon* of Nature should lie hid from the Learned; and though conscious of my own Insufficiency, and Incapacity of writing or stating the Case methodically, have at last resolved, at all Adventures, to send you a true, simple, and naked Description of it.

I have been very cautious in saying more than any Man may see there.

S I R,

Dublin,
Nov. II. 1736.

Your most obedient,
and faithful humble Servant.

Charles Lucas.

XXII. *The Case of Grace Lowdell, aged about Sixty Years, who had an extraordinary Tumour on her Thigh; communicated by John Chandler, F. R. S. from Mr. Mizaël Malfalguerat, Surgeon, at St. Edmund's-bury.*

GRACE Lowdell, a poor old Woman of the Parish of *St. James*, in *Bury St. Edmund's, Suffolk*, being naturally of a gross, fat, and relaxed Constitution, and constantly given to the drinking of strong Liquors; and consequently labouring for many Years under an ill Habit of Body, such as the Rheumatism, which had caused Contraction of some of her Fingers, with some nervous Affections in her Head, often causing some little Fits of Vertigo, &c. And though she had formerly some Child-bearing Weakness, *viz.* a *Procidentia Uteri*, yet there could not be found any other scrophulous Symptoms, than that she observed, when about Thirty Years of Age, soon after her Delivery of a Son, a little hard Swelling on the Muscle *Biceps*, and posterior, inferior and external lateral Part of the Thigh, a little above the Ham, without her knowing any manifest Occasion for it; which at first went on slowly, but after proceeding more quickly, and the older it grew, it still came on the faster, until it increased to the Bulk of near a Foot in Circumference, being somewhat of a globulous and a little longish Figure from its Basis, which was lax, like a Peduncle, or Stalk, and about half the Circumference of the Tumour, like a Neck to the Head of a Child hanging down.

From the first Appearance of this Tumour to the Excision of it, there were more than Thirty Years: She had excessive Pains and Uneasiness in it, and at last its Bulk and Weight had in some measure intercepted the Nourishment to it, so that an Ulcer had affected the inferior Part of it, very putrid and sinuous, of about Six Months standing.

This Excrecence was of the natural Colour of the Skin, and was for the most part of a pinquedinous Substance; the Centre and Basis being an *Atheroma*, but more scirrhus than common.

This Excrecence, having grown so big, was not contained in a manifest *Cystis*, but had some large Circumvolutions of Fat adherent to its common Teguments, as was observed after the Excision of it, when it was soon conveyed away; so that, through Inadvertency, we did not weigh it.

My Design in this Case was to have made a total Extirpation of this Excrecence; but by reason of its lying with large Vessels, and amongst the Tendons of the Muscles, I was content (as Dr. *Turner* advises in such Cases) "To level it, the best we can, by
" Escharotics, still repeated as the Sloughs throw off;
" till we have consumed as much of the Gland or
" Substance, and gone as deep, as may be safely ad-
" ventured; when probably some powerful Desic-
" cative may induce a *Cicatrix*, which may so tie
" the Remains, as to create no farther Trouble."

This Tumour had been shewn to most of the Physicians and Surgeons hereabouts, some of no less Skill than Note, who seemed to approve of the Operation: Therefore, *July* the 7th 1735. I made a Ligature about the Basis of it, with a Slip-knot, by
which

which I gradually constringed it once or twice a Day, as the Patient could suffer it, without causing any ill Symptoms, till the 17th of the same Month, when she was taken with strong Convulsions, a slow Fever, Syncope, her Teeth set in her Head, and a Loss of her Senses, which lasted that whole Day, and the Night following; from which time I did no more constringe the Tumour, prescribed Cordials, volatile Drops, a purging *Enema*, and a paregoric Draught at Night, which had so good an Effect, that by the next Day she was much recovered, and came to her Senses. The Ligature began to make a Separation in the Neck of this preternatural sprouting Excrecence; and on the 20th, in the Presence only of one in the Profession, having all my Apparatus before me, I extirpated the whole outward Tumour without any great *Hæmorrhage*. I was induced to use the Ligature, in order to prevent the too great Effusion of Blood, which might otherwise happen; thinking it not very safe to make a Ligature of the Body of so large an Artery as is in the Ham, for fear of intercepting afterwards the Nourishment to the Leg, as happens often after the Operation of the *Aneurisma*.

The Remains, though fordid at first, by a peculiar Method of Dressing, and proper Applications of strong Digestives, Detersives, &c. cleansed, and the Ulcer soon digested, the Substance came even to the Skin, and, *September* the 21st, it was all perfectly cured, without any Hardness, or any Inconvenience to her walking, and is like to remain always so.

XXIII. *An Extract of a Letter from Mr. James Short, of the College at Edinburgh, to Mr. Richard Graham, F. R. S.*

S I R, *Edinburgh, Nov. 18. 1736.*

— I Came here on *Saturday* last: That Evening, about Six o'Clock, there was one of the most remarkable *Aurora Boreales* that ever I saw. At first there appeared the ordinary luminous Arch, the Vertex of which was about 30° above the Horizon, and had its Centre somewhere in the Meridian Circle. After this was perfectly well formed, there appeared little or none of the purple and red Colours which are usually in that Arch; but immediately there broke out, from the most Western Extremity, a great deal of that Northern Light which formed this Arch, and, rushing along with Rays directed to the *Zenith*, formed another *Aurora Borealis* above the first, the Centre of which was to the East of the Meridian: After this was formed, there followed from the same Extremity, a great deal of purple and red-coloured Light, quivering and shaking towards the *Zenith*, with a flapping Noise in rushing along, till it formed a third *Aurora Borealis*, above the second, the Centre of which was somewhere on the East-side of the Meridian. When I was pleasing myself with this remarkable *Phænomenon*, looking again to the Western Source of these Arches, I perceived, as it were, a huge Pillar of a dull red coloured Light, rising out of the same Place whence the Arches took their Beginning, extending itself in a Direction towards the *Zenith*,

Zenith, till it rose almost 60° high. These Arches and Pillar lasted very near an Hour; the two uppermost Arches were continually quivering and shaking, and the Pillar always turning to a paler Red.

I forgot to tell you, that the Night before the *Aurora Borealis*, there was a prodigious Hurricane of Wind, which lasted till the *Saturday* Morning; but all that Day it continued to blow, though not so hard. The Arch from whence the Wind blew, was from the North-west, the same Quarter from whence the Arches took their Rise. To this Day, ever since the Hurricane of Wind, there has been a most intense Frost: It froze so hard, that in less than 24 Hours after it began, the Lake on the North side of this City was so strong as to bear People on it. Just now the Wind has changed, so that we expect a Thaw.

XXIV. *A Letter from Mr. John Freke, F.R.S. Surgeon to St. Bartholomew's Hospital to the ROYAL SOCIETY, relating a Case of extraordinary Exostoses on the Back of a Boy.*

GENTLEMEN,

I Would not have troubled you with this Account of a Case which came to my Inspection Yesterday at *St. Bartholomew's Hospital*, had I ever seen the same before in my Practice. I know it may be said to come under the Denomination of an *Exostosis*, but as all others that I have seen, which have been very many, arose upon some particular Parts, and have not
been

been found to proceed from a general Dissolution of the Bones, as this hath, I think fit to submit it to your Consideration. The Case is as follows: Yesterday there came a Boy of a healthy Look, and about Fourteen Years old, to ask of us at the Hospital, what should be done to cure him of many large Swellings on his Back, which began about Three Years since, and have continued to grow as large on many Parts as a Penny-loaf, particularly on the Left Side: They arise from all the *Vertebrae* of the Neck, and reach down to the *Os Sacrum*; they likewise arise from every Rib of his Body, and joining together in all Parts of his Back, as the Ramifications of Coral do, they make, as it were, a fixed bony Pair of Bodice. If this be found worthy your Thoughts, it will afford a Pleasure to,

GENTLEMEN,

Your most humble Servant,

*Salisbury-Court,
April 15. 1736.*

John Freke.

It is to be observed, that he had no other Symptom of the Rickets on any Joint of his Limbs.

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TAB. I.



Fig. 2.

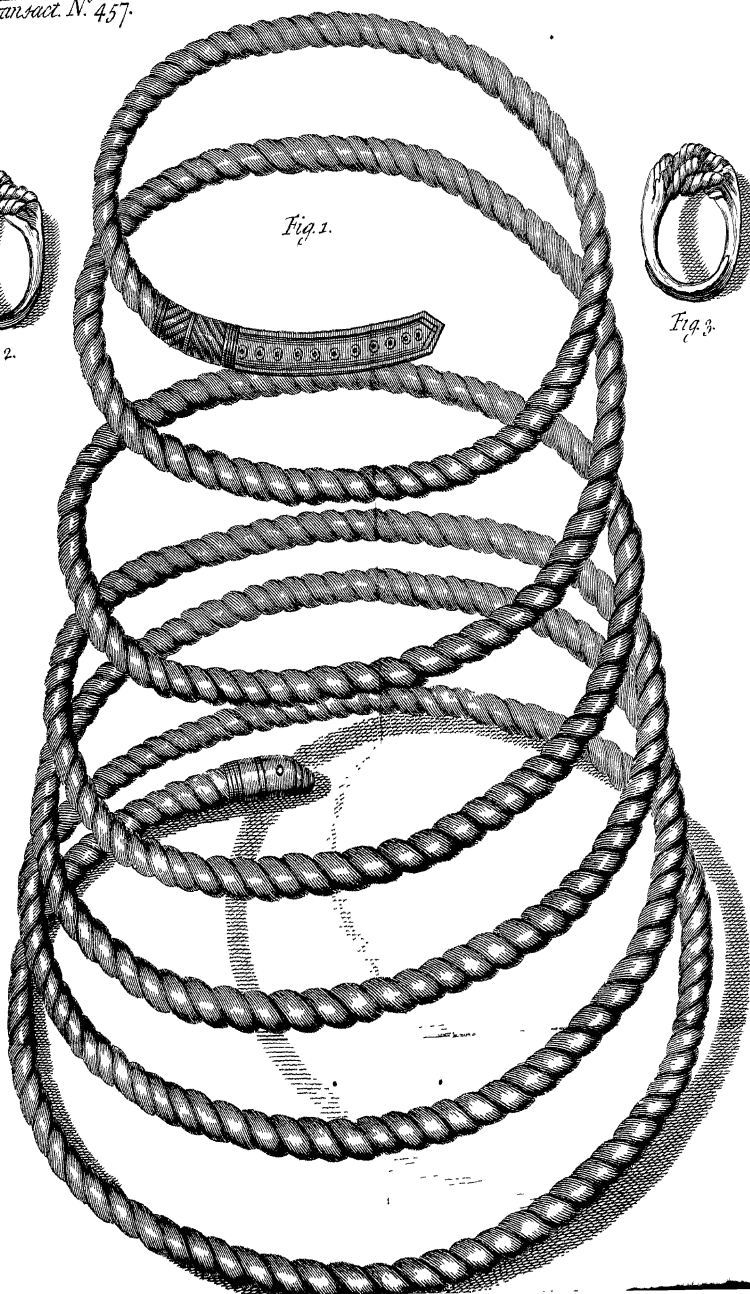
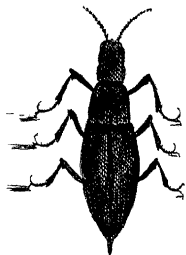


Fig. 1.



Fig. 3.

Fig. 1.



*Fig. 2. **



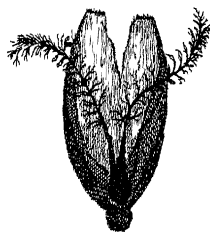
Fig 2.



Fig. 3.



B



C



Fig. 4.



B



C



PHILOSOPHICAL TRANSACTIONS.

For the Months of *July* and *August*, 1740.

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- I. *An Account by John Eames, F. R. S. of a Dissertation, containing Remarks upon the Observations made in France, in order to ascertain the Figure of the Earth, by Mr. Celsius, intituled, De observationibus pro Figura Telluris determinanda, in Gallia habitis, Disquisitio. Auctore Andrea Celso, in Acad. Upsal. Astronom. Prof. Regio, &c. Upsaliæ, 1738. 4^{to}.*

THAT the Figure of the Earth is Spheroidal is agreed upon by all: But whether it be an oblong or oblate Spheroid, *i. e.* whether the Axis be longer or shorter than a Diameter at the Equator, has been for some time a matter of Doubt. Three several Methods have been proposed to determine this Controversy by Experiments; as by the different Lengths of Pendulums vibrating Seconds, in different Latitudes; the Figure of the Earth's Shadow in Lunar Eclipses; and by the actual Measurement of the Lengths of a Degree on the Meridian in different Latitudes.

It is certain, if the Lengths of the Degrees of Latitude decrease as we go from the Equator toward the Poles, then the Axis is greater, and the Figure an oblong Spheroid; but, on the contrary, if these Lengths increase as you remove towards the Poles, the Axis is less than a Diameter at the Equator, and consequently an oblate Spheroid.

Mr. *Cassini* and others, judge the Earth to be of an oblong Spheroidical Figure; and the Observations made in *France*, if intirely to be depended upon, prove this *Hypothesis* to be a Matter of Fact. Our late illustrious President, Sir ISAAC NEWTON, Mr. *Huygens*, and others, make the Earth to be an oblate Spheroid, higher at the Equator than at the Poles; and this Figure of the Earth is undoubtedly the true one, if the Observations lately made near the Arctic Circle be admitted as certain and exact. So that since both Sets of Observations have been taken by Persons of known Skill, Dexterity, and Integrity, it is now become absolutely necessary to inquire into this Matter, in order to find out the Occasion of so great a Difference in their Conclusions.

Mr. *Celsius*, in the Treatise before us, proposes to consider this Matter more closely, and begins with a Defence of the Observations made at *Tornea*, near the North Polar Circle; and then takes Notice of some things, proper to be considered, relating to the Instruments, Astronomical Observations, and Trigonometrical Operations, performed in *France*; which, in his Judgment, render the Observations uncertain; at least so far as not to be accurate enough to be depended upon in determining the Matter in Question.

To begin with the Defence of the Observations made at *Tornea*: Perhaps it may not be improper to premise a short Account of them. They were undertaken at the Charge of the King of *France*, by Five skilful Gentlemen; Three of them Members of the *Royal Academy* at *Paris*, who were joined by Mr. *Celsius*, and the Abbé *Authier*. The Trigonometrical

Part

Part of the Work was performed near the River of *Tornea*, whose Direction is the same with the Meridian of *Tornea*; the Coasts of the Gulph of *Bothnia* being found very inconvenient for that Purpose. By the favourable Situation of Five Mountains they formed Eight Triangles, which took in Space enough for their Design. All the Five Gentlemen observed, one after another, each Angle of these Triangles, setting them down in writing separately.

They afterwards determined the Distance between *Tornea* and Mount *Kittis*, under the same Meridian, by a Basis, measured on the River when frozen over, whose Length was 7406 Toises 5 Feet, by the first Measurement; and when measured again, was barely Four Inches over. This Distance between them they found to be 55,234 Toises.

The first Part of their Work being thus finished, the next was to find the Difference of Latitude of these two Places: This they did by the Help of a Telescope, fixed to a Sector of Nine Foot, made at *London*, by the Care and Direction of Mr. *George Graham*, to whom the Lovers of Astronomy are indebted for the curious and well-contrived Instruments he has supplied them withal. The Star they observed at *Tornea* was α *Draconis*: They repeated their Observations three times, and the greatest Difference between them was but Two Seconds: Removing to Mount *Kittis*, they took the same Number of Observations, of the same Star, without finding more than One Second Difference. The Result was, that the Amplitude of the Arch, in the Heavens, between *Tornea* and Mount *Kittis*, (allowing for the Precession of the Equinox, and the Time elapsed between

the Two Observations, according to Mr. *Bradley's* Theory) was 57 Minutes 26 Seconds. Hence the Magnitude of a Degree, on the Earth, intersecting the Polar Circle, was found to be greater than a mean Degree of *France* 377 Toises; and to differ 900 Toises from what it should have been, according to Mr. *Cassini's* Hypothesis: And if the Correction, according to Mr. *Bradley's* Theory, were omitted, the Difference would have amounted to above a Thousand Toises: The Consequence of which, say the curious Observers, is, That the Earth is not only flatted towards the Poles, but that it is much more so than Sir *Isaac Newton* or Monsieur *Huygens* thought it. This unexpected Difference being so very great, made them resolve upon a careful as well as new kind of Verification of the Whole. In the first Place, they repeated their Astronomical Observations Three several times, at *Tornea* and *Kittis*, with the same Instrument, but on another Star, viz. δ *Draconis*: The Difference of Latitude between the Two Places was found to be the same, within Three Seconds and an half, with the First. They then not only examined the Truth of their Meridian Line, the Exactness of the Sector, in the different Divisions upon the Limb, chiefly in the Two Degrees employed in observing α & δ *Draconis*, but supposed that, in their Trigonometrical Operations, they had erred in each Triangle, by Twenty Seconds in each of the Two Angles, and Forty Seconds in the Third; and that all these Errors tended to diminish the Length of the Arch; the Calculation, upon this Supposition, gives but $44\frac{1}{10}$ Toises for the greatest Error that could be committed.

When

When a particular Relation of all these Observations was read before the *Royal Academy of Sciences* at *Paris*, and inquired into; the main Exception taken to them was, That the Observers, omitting to make a Proof of the Line of Collimation, by means of double Observations, with the Face of their Instrument turned contrary Ways, have thereby not duly ascertained the Truth of their Observations. But this Objection was fully answered by Monsieur *Maupertuis*, as Mr. *Celsius* hopes and believes, to the intire Satisfaction of Monsieur *Cassini*, who made it. He allows M. *Cassini* had very good Reason to mention this, as a thing proper to be done in Instruments of common Use, for this Purpose, which generally stand in need of such a Method of Verification: But it was not at all necessary in the Instrument used at *Tornea* and Mount *Kittis*: The very Make of it was such, that no Alteration could easily be made in it, so as to create any perceptible Error in the Observations. The whole Apparatus of the Telescope and Sector is all framed together; the Object-glass and Cross-wires, as well as the Limb, so firmly fixed to the Tube, as not to be dislocated without great Violence. Notwithstanding all this, the utmost Care was taken in transporting it from one Place to another; being placed in a Chest, that the *Laplanders*, to use his own Words, *in illa cista idolum quoddam servari facile sibi persuaderent*. He adds, the same Objection may be made to Monsieur *Picard*'s Observations, who does not seem to have used this Precaution, as Monsieur *Cassini* himself acknowledges, who nevertheless approves and extols his Observations for their Accuracy: So that those at the Arctic
Circle

Circle may be very good, notwithstanding the want of this, supposed necessary, Operation. And indeed, that they were so, sufficiently appears from this Fact. The Difference of Latitude between *Tornea* and Mount *Kittis*, found in *September*, was observed again in *March* following, by the Help of the same Star δ *Draconis*, and did not differ from the former above $3\frac{1}{2}$ Seconds, though the Instrument had been twice carried from one Place to the other. This is a Degree of Exactness not easy to be met with; no not in Monsieur *Cassini's* Observations, made on different Stars, which differ sometimes 40 Seconds, in determining the Amplitude of an Arc in the Heavens, though their Instrument was carefully examined in the way above-mentioned.

The Author then proceeds, in his Turn, to inquire into the Accuracy and Certainty of the two Sets of Observations made in the North and South Parts of *France*, in respect of the Royal Observatory at *Paris*.

As to the Measures of the Degrees in the Northern Parts of *France*, between *Paris* and *Dunkirk*, he owns they cannot be much out of the way; being in some measure confirmed by Monsieur *De la Hire*, in the Year 1683. and Monsieur *Cassini* himself. Yet Mr. *Celsus* observes, that the Basis on the sandy plain Shore, near *Dunkirk*, when measured again, differed Three Feet from the former Measurement; which is a much greater Difference than that Mr. *Celsus* and the other Gentlemen found, in measuring a much longer Line twice over, which was but Four Inches.

As to the Astronomical Observations taken by the Six Foot Sector, whose Limb of 12 Degrees was divided only at every 20 Seconds; it is true, Monsieur

Cassini

Cassini examined the Instrument several ways, at *Paris*, after his Return thither: but that a Correction, owing to the Change of Centre, might be safely applied to the Observations at *Dunkirk*, the Examen of the Centre should also have been taken at *Dunkirk*; it being uncertain, whether this Alteration or Aberration of the Centre was caused by the Journey to or from *Dunkirk*.

The Difference of 41 Seconds between the Observations taken to settle the true Measure of the Arc of the Heavens, seems to be enormous. Perhaps the Stars were not lucid enough to be well observed by the Three Foot Tube; but might they not, for a due Degree of Accuracy, have been viewed through the Nine or Ten Foot Telescope?

Our Author prefers the Observations of 1719, made after the Return to *Paris*, to those made before; because made at the same time of the Year with those of *Dunkirk*, and so not standing in need of Mr. *Bradley's* Correction: Though this Caution, perhaps, may be thought not necessary here, where the Errors of the Observations are greater than the Correction itself. Mr. *Celsus* remarks farther, if the Difference of Latitude between *Dunkirk* and *Paris* be supposed to be Two Degrees 12 Minutes 12 Seconds and an half, which is a Mean between Four others he mentions, the Length of a Degree will amount to but 56,395 Toises. And if the Observations at *Malvoisine* and *Amiens*, be counted according to Mr. *Bradley's* Theory, for the Interval of a Month between the Observations, the Length of a Degree will come out to be 56,926 Toises; which is 135 Toises less than the Length of a Degree; found
by

by measuring the whole Length of *France*; and 134 less than that of *Mr. Picard*, so highly approved of by *Mr. Cassini*, as confirming his own.

The Reflections Mr. Celsius makes upon the Observations, &c. taken in the South Parts of France, shall be referred to another Meeting.

The Continuation of the Remarks made by Mr. Celsius on the Observations taken in France, in order to ascertain the true Figure of the Earth.

MR. Celsius having finished his Remarks upon the Observations made in the North Part of *France*, extending from *Paris* to *Dunkirk*, proceeds to examine those taken in the South, from *Paris* to *Collioure*, near the Borders of *Spain*, and the *Pyrenean* Mountains. By the former, a mean Degree was found to consist of 56,960 Toises, by the latter 57,097; and consequently the Earth is an oblong Spheroid.

Mr. Celsius, in examining these Observations, which were taken under the Conduct and Direction of the late *M. Cassini* in 1700, first considers the Structure and Goodness of the Instruments used; then the Accuracy of the Astronomical Observations for finding the Difference of Latitude; and, in the last place, the Trigonometrical Operations for determining the Distances of Places; especially the two Extremes under the same Meridian.

The

The principal Instrument M. *Cassini* carried with him, was, a Limb of 12 Degrees, whose Radius was indeed 10 Foot, but divided only into Degrees and Minutes; the other Parts were added to it at *Perpignan*. Here Mr. *Celsius* observes, that the finding the true Centre of this Limb was and still is a very difficult and troublesome Problem to a good Artist; that no mention is made, whether the Position or Place of this Centre, and the Divisions of the Limb, were ever examined at *Paris* or *Collioure*, though the Carriage of the Instrument through so long and rough a Way, could not but make some Alteration in the Place of the Centre.

It is true, the Zenith Distance of *Capella*, taken by it at *Paris*, was confirmed to be right by another Instrument; but it cannot be concluded, that the Zenith Distance of the same Star, taken at *Collioure* by this Instrument, and not confirmed there by another Instrument, must be true also. For the Point of Division, answering to this Distance in the Limb, was not examined; and a Centre wrong placed may by Accident give the true Zenith Distance, *viz.* when the true and erroneous Centre happen to lie in the same Perpendicular to the Horizon.

The Exceptions taken to the Astronomical Observations for finding the Difference of Latitude between *Paris* and *Collioure*, are, in the first place, That though Five Stars were observed at *Collioure* and *Paris*, yet One only was made use of, *viz.* *Capella*: That the Difference of Latitude by *Capella* is $6^{\circ} 18' 57''$: If *Lucida Lyra* had been used, the Difference would have been but $6^{\circ} 17' 7''$; but by the Right Shoulder of *Auriga*, $6^{\circ} 19' 25''$: Hence arises the

Uncertainty or Difference of $2' 18''$ between the greatest and least of their Observations: That the late Mr. *Cassini* makes the Difference $57''$ less than Mr. *Cassini*, who accounts for this Difference from the Observations being taken by an ordinary Instrument; but the Instrument is the same which was used to take the Altitude of the Pole of *Amiens*, which was very near that found by Mr. *Picard*.

As to the Trigonometrical Operations for finding the Distance of Places, Mr. *Celsius* thinks they labour under considerable Uncertainties; not only on the Account of the many Difficulties they met withal, viz. mountainous Countries, want of proper Signals, &c. so that convenient Triangles could not be formed; but add to all these, several of the Triangles had but Two Angles observed, and some of these Angles too acute; whence, as Mr. *Cassini* himself very justly observes, in his Examination of *Snel-lius* and *Riccioli's* Observations, great Errors may arise. Mr. *Picard* thinks all Angles less than 20 Degrees ought to be avoided; as also that the Triangles should be contrived so as to have Sides of a due Length, neither too great nor too small: Then follow 16 Triangles, wherein one or more of these Inconveniences are to be found.

It may be said, the Whole of these Observations and Measures of Monsieur *Cassini* seem to be sufficiently confirmed, if not ascertained; since the principal Base in *Roussillon* was found, when computed, to differ but Three Toises from the same as it was actually measured; and that, after some due Corrections, it was made to agree with the greatest Exactness. Mr. *Celsius* replies, Why are we not told
what

what those Corrections were, that we may see whether they were really necessary or no? Why were they not taken notice of in the Calculations of each Triangle? Besides, the real Length of the Base, or the fundamental Line, in *Roussillon*, is not fully ascertained, it not being measured more than once; whereas that at *Dunkirk* and that of Mr. *Picard* were measured twice; and there was more Reason for doing so here than at *Dunkirk*, on account of the uneven and almost ever changing Shore in *Roussillon*, from the restless overflowing Sea.

The great Number of the Triangles, joined with the numerous small Errors of the Angles, is another Ground of Uncertainty; for the Errors in the Angles, though small, may make the Distance of the Parallels of the Two extreme Places greater than it ought to be; and yet the principal Sides, that is, those that are made Bases to the following Triangles, continue the same. This made it necessary to verify the Sides, at least at every second Degree, by measuring the principal Base twice over with due Care; which might have been done, and therefore should have been done, in a Matter of so much Nicety as an Attempt to find the Difference between Two Degrees so near one another, under the same Meridian.

To shew what bad Consequences may arise from small Errors committed in observing the Angles of several Triangles, Mr. *Olaus Hiorter*, a curious and ingenious Friend of Mr. *Celsius*, has taken the Pains to form the Triangles of Mr. *Cassini* between *Bourges* and *Collioure*; so that the Distance between their Parallels shall be considerably lessened; and yet the Base in *Roussillon*, found by Computation, shall not, after due Correction, differ sensibly, if at all, from

the same actually measured. In consequence of this, Mr. *Celsius* concludes with observing, that the Distance between the Royal Observatory and the Perpendicular to the Meridian of *Collioure*, deduced from the Triangles of *Cassini*, corrected after Mr. *Hiorter's* Method, &c. will amount to but 358,980 Toises. This, divided by the mean Difference of their Latitudes, $6^{\circ} 19' 11''$, will give 56,803 Toises, for the Length of a Degree, one with another, between *Paris* and *Collioure*, which is less than the Length of a mean Degree found by Mr. *Picard*, and pretty near the Truth: So that the Degrees decrease as you go towards the Equator; and consequently the Earth is higher at the Equator than at the Poles, as Sir *Isaac Newton* and Mr. *Huygens* believed.

The Distance of the Parallels of *Paris* and *Collioure* by this Method is indeed less than that computed by Mr. *Cassini*; but this cannot reasonably be complained of, since these computed Measures of Mr. *Cassini* seem very capable of being lessened; and it is no more than what Mr. *Cassini* himself hath done to the Measures published by his Father, which he has shortened by $325 \frac{1}{2}$ Toises. But however that Matter be, whether this particular Correction of Mr. *Cassini's* Distance, and, consequently, Length of a mean Degree, be admitted or no, Mr. *Celsius* is fully persuaded, upon the Whole, that he hath made it plain to every unprejudiced Reader, that these Two Sets of Observations in *France* are not taken with such a Degree of Exactness as to be depended upon, in determining so nice a Matter, in Dispute for 50 Years, as the true Figure of the Earth; which was the thing proposed to be done by them.

II. *A Letter from Mr. J. Alexander to Peter Collinson, F. R. S. concerning a Place in New-York for measuring a Degree of Latitude.*

S I R,

New-York, July 21. 1740.

THE Mention of the *French* Endeavours to discover the Figure of the Earth by Observation, puts me in Mind—That a very exact Observation for that Purpose might be made here, because *Hudson's* River here is frozen over from *New-York* up to *Albany*, and its Course is very strait, almost true North, and the Distance between *New-York* and *Albany* is above One hundred and Fifty Miles; *New-York* is in Latitude of $40^{\circ} 40'$, nearly; so that the Length of above Two Degrees of Latitude on the Earth might be measured here, with much more Exactness than it was possible in *England* or *France*, because of the Ascents and Descents, and curved Lines, which, I think, they would continually be obliged to make Allowances for.

From all which Difficulties the Mensuration here on the Ice would be intirely clear.

Yours,

J. Alexander.

III. *Ex Veterum Prussorum RE ANTIQUARIA Schediasma, a D. Jac. Theodoro Klein Reipubl. Gedan. a Secretis, R. S. S. cum D. Hans Sloane, Bar^o. R. S. Pr. communicatum.*

INTER varia Veterum Prussorum & Utenfilium & Luxus sui vel Ornamenti monumenta, olim circa funerationes terræ concredita, rursus e terra aliquando eruuntur ex Ære ductili affabre tornatæ complicaræque triplices lineæ, quæ vel laxatum Cingulum ex unico aut duplici triplicive circulo constantem effingunt, vel Coni figuram e basi sua per Spiram assurgentis, apice truncato repræsentant, cujus Spiræ ex ære nobiliori tam egregia elasticitas, ut facile comprimi & facilius in figuram conoidalem remitti queat, ita quidem, ut plus quam quatuor horæ minuta requirat, antequam ab impulsu requiescat.

Prioris Generis de Historia naturali optime meritus *Hekwingius Præpos. Diæco. Algerb. Lithograph. I. p. 91. §. 2.* Funiculos metallicos vocat, eosque Cinguli loco destinatos fuisse recte judicat; illos, qui in Conum truncatum assurgunt, CORONAS SEPULCRALES (*ibid. §. 4.*) appellat, in Sepulcretis obvias, sed rarissime integras.

SIMILEM, ex omni parte integram & liberam ab Æruginē, (*vid. TAB. I. Fig. 1.*) cujus Diameter in basi $6\frac{7}{8}$ pollices Rhinland. adæquat, anno 1726. in Museum nostrum deposuit vir admodum Reverendus, simulque Sententiam suam in literis ad me datis exposuit; nimirum, hujusmodi Conum spiralem fuisse Simulacrum Serpentis ænei Israelitarum, cum quibus veteres
Prussi

Prussi multa circa Cultus suos Idololatricos communia habuerint, quod Simulacrum demum loco Amuleti in Sepulcra deposuerint; ut Serpentes, quos Prussi veteres pro Diis coluerunt, post obitum quoque reverenter habiti, Cadaveribus non nocerent.

Proculdubio Vir Doctissimus hujus gratia secutus est Castra eorum, qui Virgines Veterum Prussorum ab Israelitis, quos *Salmanassar* in captivitatem abduxit, deducere satagunt; quorum tamen opinionem *Christoph. Hartznock, Dissert. III. p. 48. §. v.* labefactavit.

Ast, licet verum sit, Prussios Ethnicos præter DIOS majores, *Percunum, Pikollum, & Potrimpum*, imo præter Solem, Lunam, Stellam, Lucos, Fontes, Alcem, Bufones, aliasque Bestias, etiam Serpentes veneratos, eosdemque & cultu & litamine ex lacte parato, in Quercubus præcipue cavis, quæ inaudita plerumque magnitudinis & crassitici, (*vid. Hartknock Dissert. VI. de locis Divino cultui dicatis*) profecutos esse*; licet quoque egomet ipse in Lithuania Prussiarum orientali subjecta sæpius observaverim, Serpentes infantibus adeo familiares esse, ut iisdem cochlearia lacte plena circumverterint, quorum esurientium ejulatu Parentes accersiti nihil contra indiscretos hospites ausi sunt, nisi quod eosdem pariter ac volatilia domestica a prandiis liberorum fugaverint: nullatenus tamen exinde inferri poterit, Prussios antiquos hac ærea Spira respectum habuisse ad Serpentem æneum. MOÏSIS, nisi nobis etiam persuadere velimus, quod

* Qua ratione, quibusve Cæremoniis epula Serpentibus sint parata, *vid. Hartkn. in Ant. & Nova Prussia, p. 63. Conf. Dissert. ejus VIII.*

respectu Afflictionum Ægyptiacarum, nimirum 2^{dæ}, 3^{tiæ}, 4^{tiæ} & 8^{væ}, Bufones, Ranas, & plurima Insecta singulari cultu sint profecuti, eorundemque simulacra sibi comparasse. Neque verisimile est, ex veneratione erga Serpentes, quos, forsan ultra numerum, vivos in Ollis conservarunt, iisdemque valde familiares fuerunt, eorum insuper Idola, & multo minus Amuleta Serpentiniformia fabricasse, ut Cadaveribus sepultis de Serpentibus caverent, cum extra dubium est, quod veteres Prussi mortuos non aliter quam crematos terræ mandaverint, cujusmodi funerationes temporibus Ducis *Alberti* necdum aboliri potuerunt, hinc Cadavera Amuletis contra injuriam Serpentum non indignisse. Cum, quod reliquum est, notissimum sit, veteres Prussos per Secula rudissimum fuisse populum, (*vid. Henneberger, in libr. de vet. Pruss. fol. 5.*) qui nec lanas ducere, nec ferrum, multo minus ænea vel utensilia vel luxui inservientia vasa parare didicerint, quin potius pro Hastis & Ensisbus Clavos horribiles, & pro malleis cuneisque ferreis lapides ad usus & domesticos & bellicos (qui diu sub nomine Cerauniarum venditati sunt) adaptaverint, nihilominus tamen non sine omni industria.

Summa itaque præmissorum hæc: Ceimelium nostrum nullam relationem ad simulacrum Serpentis ænei Moïsis habuisse, multo minus Probabilitatem Amuleti contra morsus Serpentum involvere; neque ex antiquissimis veterum Prussorum temporibus, sed ex medio potius eorum ævo originem trahere.

Unde autem Clarissimus *Helwingius* in *Alleg.* §. 4. adductus fuerit, ut vetus hoc monumentum titulo Coronæ Sepulcralis insigniverit, hariolari non possumus; quippe neque figura ullo modo Coronam æmu-

æmulatur, nisi dicere velis, Philosophiam Prussorum, occasione funerationis, quæ causa quandoque maxime lugubris, prout mors homini naturali omnium terribilissimum est, Coronæ loco ejusmodi Spiram tremulam excogitasse; neque apud ullum Auctorem vestigium apparet, veteres Prussos mortuos suos cum ejusmodi Cæremoniis, quibus nos utimur, ad funerationes exportasse, ita ut Virginis vel Juvenis loculum Corona ornaverint; cum neque ullibi Coronæ Sepulcralis mentio sit facta, quæ in honorem Defuncti vel ad latus ejusdem, vel ad caput, vel etiam ad pedes, prout apud nos viris, qui in Coelibatu supremum obierunt diem, in Sepulchro deposita fuerit.

Sufficient autem sequentia, quæ Summam rituum funerandi Defunctos exhibent ex fide nostri *Hartknochii Dissert. XIII de Funeribus Vet. Pruss. p. 193. seq.* præter reliqua: “ Cum Defunctus erat tumulo
 “ inferendus, primo pyræ impositus comburebatur,
 “ deinde optimæ quoque vestes rogo injiciebantur, ut
 “ & canes venatici, equi, arma, aliaque defuncto,
 “ dum viveret, acceptissima.—Injiciebant quoque
 “ Annulos æreos, ut & Armillas æreas, præsertim si
 “ defunctus Christianorum sacra susceperat.” Et paulo post ex *Erasmo Stella*: “ Exutos spiritu, ar-
 “ matos vestitosque, ac magna Supellectilis parte
 “ circumposita, humarunt.”—Denum ex *Jacobi Leodiniensis* Privilegio Prussis dato: “ Promiserunt
 “ (Prusli) quod ipse & Hæredes eorum in mortuis
 “ comburendis vel subterrandis cum equis, sive homi-
 “ nibus, vel cum armis seu vestibus, vel quibus-
 “ cunque aliis rebus pretiosis, vel etiam aliis quibus-
 “ cunque ritus gentilium de cætero non servabunt,

“ sed mortuos suos juxta morem Christianorum in
 “ Coemeteriis sepelient.”

His omnibus rite perpensis, confidimus jure affirmare posse, Monumentum, de quo nobis sermo est, ad Supellectilem veterum Prussorum, & quidem Nobilioris Ordinis spectasse, & non nisi ARMILLAM, qua defunctus vel defuncta, sive in signum optimè de Patria meritum vel Nobilitatis, sive singularis ornatus luxusque gratia usi sunt, fuisse, quæ cum reliqua Supellectilis parte circum Cadaver posita tali modo in terram devenerit, donec nostris temporibus aliquando in lucem rursus extrahatur.

Confirmavit sententiam nostram Doctissimus *Thomas Bartholinus*, qui in *Schedio* suo de *Armillis Veterum*, pag. 48. figuram exhibet Armillæ Brachialis pluribus Circulis inter se connexis ex Museo Antiquario *Olai Wormii*, nunquam ab aliis annotatæ; quam pag. 49. stupendæ Antiquitatis monumentum, dignum posterorum memoria appellat. Quæ si cum nostro Ceimelio debite conferatur, nescio, quid obstarer, quo minus Nostram ARMILLAM BRACHIALEM veterum Prussorum, & quidem pari jure cum *Wormii* Armilla, stupendæ Antiquitatis nostræ monumentum, nunquam ab aliis annotatum dignumque Posterorum memoria salutaremus.

Structura ejus laxior insuper magisque fluens, quam *Wormii* Armilla, est, ita ut super manica Brachii applicata Humerum Cubitumque simul commode stringere possit. Neque pro Plebeia, quod ærea est, censeari credas; cum aureas vel argenteas apud nos unquam effossas non audiverim. Ast Plebeiarum vestigia in hunc usque diem supersunt circa Ornatus
 utri-

utriusque Sexus in Lithuania Prussiae orientalis, qui veri Prussorum veterum Descendentes, & Curlandiae, qui diebus in primis solennibus Ossa Cubiti eadem plane figura, qua Armilla aerea apparet, arctius licet, vel ex serico & lana contextis fasciis (si ditiores sunt) vel Fimbriis variegatis cujuscunque Panni (si pauperiores) constringunt. Moris iisdem adhuc quoque est, Abdomine minimum duobus & quidem similibus cingulis victo, superbire.

Propter affinitatem cum Armilla hac Brachiali veterum Prussorum, libet eidem adjungere Annulum regenteum, (*vid.* TAB. I. Fig. 2 & 3.) quem ante annum, & quod superfluxit temporis spatium, vir prænob. Dⁿ. *Andreas Lilienthal*, S. R. Maj. Boruss. a Consiliis Belli & Redituum, Camerae Regalis, in Urna Prussica effossa inventum mihi tradidit, similibus lineis convolutis pro Gemma contextis, reliquo in duas extremitates sibi non conjunctas, sed invicem vicinas, circulumque formantes, excurrentem, ita ut digitum plus minusve crassum æqualiter ambire possit.

Expedito hoc Schediasmate a Viro Consulari Gravissimo Dⁿ. *C. G. Ehlero* ex Diario, quod 1734. & 1735. Petropoli præsens per Filium suum conscribi curavit, & edocti sumus, Toreumata non nisi Aurea varii generis, ad nostrum Ceimelium æreum proxime accedentia in ditissimo totius Russiæ Autocratricis Antiquitatum Thesauro, ubi inprimis Sinensia afferuntur, observata: Quæ Bibliothecarius Sacrae Imperialis Majestatis ex Sepulcretis, nescitur tamen cujus regionis, effossa esse & pro Armillis haberi affirmaverat.

IV. *Observations and Experiments with Mad-
der-root, which has the Faculty of tinging
the Bones of living Animals of a red Colour,
by M. Du Hamel du Monceau, F. R. S. &c.
communicated in a Letter to Sir Hans Sloane,
Bar^t. Pr. R. S. Translated from the French
by T. S. M. D. F. R. S.*

IN the Month of *February* 1737. (N. S.) Monsieur *Geoffroy* communicated to the *Royal Academy of Sciences at Paris*, the following Observation, extracted from a Letter of Sir *Hans Sloane*, Bart. President of the ROYAL SOCIETY of *London*, to him.

“ Mr. *Belshier*, a Surgeon, and Member of that
“ SOCIETY, dining one Day with a Callicoe-printer,
“ remarked that in a Leg of fresh Pork, the Flesh of
“ which was well-tasted, the Bones were red. He
“ asked the Cause of so singular a thing, and was
“ told, that these Callicoe-printers make use of the
“ *Rubia Tinctorum*, or *Madder-root*, to fix the Co-
“ lours printed on the Cloth. Some of these Colours
“ are made with Preparations from Iron, others with
“ a Mixture of Alum and Sugar of Lead. The Parts
“ printed with the Preparation of Iron, produce
“ Black and Purple; those printed with the Mixture
“ of Alum, Red of different Degrees. These Cal-
“ licoes are afterwards boiled in a Copper with Bran,
“ in order to clean them from a dirty red Colour
“ occasioned by an Infusion of *Madder-root*. In
“ fine, that this Bran should not be lost, though
“ charged

“ charged with a red Colour, it is mixed with the
 “ usual Food of these Hogs; and this is what pro-
 “ duces this Effect on their Bones, without causing
 “ the least Alteration either in the Flesh, Membranes,
 “ Cartilages, or any other Parts of the Body. Mr.
 “ *Belchier*, whose Observation here related has been
 “ communicated to the Public in N^o 442. and 443.
 “ of the *Philosophical Transactions*, desiring to be
 “ assured whether the *Madder* alone, or all the In-
 “ gredients blended together, produced this Colour
 “ in the Bones, made some other Experiments.

“ He mixed some of the *Madder-root* with the
 “ Food with which he intended to feed a Cock.
 “ The Cock dying within 16 Days after his first
 “ feeding on the *Madder*, he dissected him, and was
 “ surprised to find, that the Root had produced its
 “ Effect in so small a time; for he found the Bones
 “ universally of a red Colour. Whence he con-
 “ cludes, that the *Madder* alone causes this Altera-
 “ tion; as he had not mixed either the Iron, Alum,
 “ or any of the other Ingredients of the Dyer, with
 “ the Cock’s Food. He remarked, that the red Co-
 “ lour penetrated into the internal Parts of the Bones,
 “ and that the hardest Bones took more of this Co-
 “ lour than the softer ones; excepting the enameled
 “ Part of the Teeth, which in the Hog retained its
 “ Whiteness.”

Mr. *Belchier* promises, at the Close of his Obser-
 vation, to try further Experiments, in order to know
 with Certainty, why this Change of Colour takes
 place only in the Bones. But as he has not published
 any thing more than what I have above related, I
 think myself at Liberty to communicate to the Public
 the

the Experiments I began to make in the Country, soon after the Observation came to my Knowledge. They are a Confirmation of it, and diminish nothing of the Merit of the first Discovery.

It is proper to observe, that *Mizaldus*, in a Work published in 1566. with this Title, *Memorabilium, utitium ac jucundorum Centuriæ novem*, (Cent. 7. No.) has these Words: “ Erythrodanum, vulgo
“ *Rubia tinctorum* dictum, ossa pecudum rubenti
“ & sandycino colore imbuat, si dies aliquot illud
“ depastæ sint oves, etiam intacta radice, quæ rutila
“ existit, &c.”

First, I took Four strong Pullets, which I shut up in Coops. I fed them with a Paste made of Wheat-meal and Powder of *Madder-root*; and gave them an Infusion of the same Root to drink, which I was in hopes they would have no Dislike to. The first Days they eat their Paste pretty well; but I found, that the Addition of the *Madder* rendered it much less agreeable to them than that made of the Meal alone, on which they fell with much greater Eagerness than on the other, when, to try their Relish, I now-and-then gave them some of it. As to the Infusion of the *Rubia Tinctorum*, they never would drink it, and I was obliged to give them pure Water, which they drank plentifully; for this Root made them thirsty. In short, at the End of some Days they could not relish the Mixture, of which they eat but very little, and wasted away visibly.

On the 10th Day, one of them died; and another Two Days after: and both of them had their Bones tinged of a Rose-colour. In order to prolong the Lives of the other Two, I diminished the Dose of
the

the *Madder*, and from time to time I gave them the *Paste* without it. The Root had already produced its Effect; for notwithstanding the new Regimen, they continued to waste; which obliged me to kill the Third Five Days after the Death of the first Two. The Colour of its Bones was not different from that of the Two, who died Five Days before. As to the Fourth Pullet, which seemed not quite so sick, I marked it on the Leg with a Bit of Cloth tied round, and set it at Liberty. It recovered by degrees, by choosing Food to its Taste in the Yard. But at the same time the Tincture its Bones had received, went off gradually, and almost intirely disappeared in a Month's time. For I took care to observe the Change every second or third Day, by looking at the Bones on the Under-side of the Wing, which have no other Covering than a thin Skin.

From this Experiment, as from that of Mr. *Belchier's* Cock, it appears, that the *Madder-root* is alone sufficient to tinge the Bones of Animals red, which eat it. The Bones of my Pullets had taken no more than a Rose-colour; because these Creatures, being disgusted with their Food, never eat of it, but when urged by extreme Hunger: And I had never been able to tinge them of a fine red Colour, had I not repeated the Experiment on such Animals as I could feed with the *Paste*, and had it in my Power to make them swallow *Madder* in large Quantities.

For that Purpose I chose young Pigeons, the strongest of a whole Pigeon-house. Two of these had no other Food given them but Wheat-meal, others were fed with the Meal and *Madder* mixed
and

and made into Pellets of a convenient Size, given them Three times a Day till their Crops were full. I endeavoured to make the young Pigeons drink of the Infusion of *Madder*, which were fed with the Root and Meal; but I could never succeed, and was obliged to give them Water alone, as to the Pullets of the First Experiment. The Two young Pigeons fed with the Meal alone were lively and fat, digested their Food, and throve as well as if fed by the old ones. But on the contrary, those that were fed with the Paste of Meal and *Madder*, took this Food only by Force, digested ill, were dull and very thirsty. And though Care was taken to keep their Crop constantly full, as well as the others, yet they grew leaner daily. They were always shivering, and endeavouring to get into the Sun, or near the Fire, to warm themselves: And the strongest of them was very sick by the 10th Day. I got the Two killed, that had fed on the Meal alone, as well as the others that had the *Madder* given them; and I preserved but Two, which appeared to me to have better borne the Effect of it than the rest, and had the Bones of the Wings already tinged red.

One of the Two was intended to be recoverd by a simple Diet, in order to see, if, by prolonging its Life, the Colour, which was already very visible in the Wing-bones, would wear off: But in Three Days time it was killed accidentally. However, I thought I perceived the Colour weaker than before the Change of Diet: And the same Experiment, repeated some time after, confirmed me (in the Notion) that the Change of Food makes the Colour disappear by degrees. I continued to feed the other remaining
young

young Pigeon with *Madder*, but in small Quantities, for fear of killing it too soon. It lived Eight Days longer without any Appearance of the Bones being deeper coloured than the first that were killed.

All these Creatures, that had been fed with the Mixture, were dissected; and I made the following Observations on them.

Neither the Feathers, the Horn of the Bill, nor Claws, had changed their Colour, even where they are inserted into the Skin. The Skin of the whole Body had preserved its natural Colour. The Brain, Nerves, Muscles, Tendons, Cartilages, *Epiphyses*, and Membranes, afforded nothing to the Sight contrary to the usual State of these Parts. But the long bony Tendons, that run along the great Bone, which is improperly called the Leg of Fowls, were red about the Middle of their Length, which is their hardest Part. All the true Bones, even to the very thinnest of them, were as red as Carmine; and in some Places this Red was so deep, that they appeared almost black.

In these young Birds, all the Bones do not take the red Tinge alike. The hardest are generally more coloured than those that are tenderer. A Difference of this kind is perceivable even in the same Bone; for the Middle, which has more Solidity than the Ends, is almost always the reddest. Not but there are sometimes found little pale Spots in the Part where the Red is deepest; and sometimes Spots of a very deep Red in those Parts which have taken but a Carnation Tinge.

I have always found, that the great Bone of the Foot, which is commonly called the Bone of the

Leg, was visibly less red than the others. I have found the little Bones of the *Larynx* and of the *Apophyses* tinged of a fine Red, though these are as small as a Thread in young Pigeons. The Rings of the *Trachea*, which are intirely cartilaginous, had not taken the least Tinge; but the Ring nearest the Division of the *Trachea* was red in these Pigeons; and even the First Ring of each Branch of the Bifurcation had in several taken the Tincture, in the Middle at least of its Outside.

The other Parts of the Thorax, *viz.* The Heart, Lungs, *Mediastinum*, *Pleura*, and Diaphragm, remained of their natural Colour. There was nothing remarkable in the Liver, Spleen, Kidneys, nor on the Outside of the Gizzard; but the inner Membrane of the Crop and Intestines, especially the large ones, appeared red. Having washed Pieces of these Crops and Intestines, I found that their outer Membrane continued white, and that the inner, or *Tunica Villosa*, only was tinged by the *Madder*. At first Sight it appeared to me as if injected; but upon examining it with a Glass, I saw distinctly, that it was not a coloured Liquor that was contained in Vessels, as in Parts injected; but that it was only a sort of *Fæcula* detained in the villose Part of these Membranes. It is doubtless the Adhesion of these tinging Particles of the Root to the small *Villi* of the inner Membranes of the Organs of Digestion, that is the Source of all the Distempers with which these Creatures appeared to be seized, while I fed them with the *Madder*. Their Crop especially was relaxed and flabby, as if it had been macerated several Months in Water; it was easily torn, and its inner or villose Membrane ad-

adhered so little to the others, that it was detached from them in Pieces. It is very probable, that the coloured *Facula* detached from the *Madder*, that is, the Part of the Root which gives the Tincture, had obstructed the small Vessels and Glands of the Stomach, which might possibly occasion a *Sphacelus* therein. However that be, a certain Quantity of this *Facula*, being accumulated there, retarded Digestion, and those Animals died hectic, though with a full Stomach.

The Eyes of these Animals, while alive, seemed as red as those of some Parrots. I thought, after having dissected them, that no other Part was coloured but the *Capsula* of the Crystalline: But Monsieur *Morand*, to whom I had sent a Turkey fed with the *Madder*, observed that the vitreous *Capsula* was of a crimson Red, though neither the vitreous Humour nor the Crystalline were dyed: The Eye of this Turkey being larger than those of the Pigeons, the Hand that dissected it much more dexterous than mine, and the Anatomist more knowing, I willingly come into his Opinion. This then is the only soft Part, that is really tinged in these Animals; for I do not look on those Parts as such, which appear so only by their immediate Contact with those Parts that are charged with the Colour: Monsieur *Morand* having, in the Notes he sent me of his Observations, confirmed all that I had before observed, there ought to remain no Doubt of what I have here related.

I come to the Examination of the Skeletons, and of all the coloured osseous Parts of my Pigeons; in order to compare them with the Skeletons of the Two Pigeons fed with Wheat-meal alone without

the *Madder*. The Bones of the first were, as I have said above, of a very lively Carmine-red, in some Places of a Crimson; and I have some of them of the Colour of yellow Okre; but whence this Difference arose, I could not discover. These tinged Bones being broke, while fresh, or before drying in the Air, seemed to me somewhat bigger and fuller of Marrow; but also more spongy, or of a looser Texture, and easier to break, than the white Bones of the Pigeons fed with Meal only. The Parts of these Bones that had the least Degree of Hardness, broke between the Fingers, which remained coloured from them: And this Tincture does not come from the Marrow, which continues in its natural State, like all the other soft Parts. The same Parts in the white Bones were not to be broke in this manner.

If we recollect, that the Pigeons fed with the Mixture of Meal and *Madder* are always in a languishing Condition, in a continual Decay; it will be easy to judge, that this is the only Reason why the red Bones must be not so well formed, nor so hard, as the white Bones of the Pigeons fed with good Aliments. But why are they bigger, and, as it were, puffed up? It is hard to suppose any other Cause of this, but the Interposition of the colouring *Fæcula* of the *Madder* between the *Lamellæ* of the Bones. These heterogencous Particles hinder the immediate Contact of these *Lamellæ*; and thence proceeds the preternatural Increase of their Size, and their little Solidity. Upon viewing these Bones with a good Glass, their smoothest Surface appears bored with a vast Number of small Holes, in which the colouring *Fæcula* is perceived. And with a Microscope that
mag-

magnifies still more, there appears a sort of Net-work of Fibres, which divide, and reunite, to form this Net. Under the first Order of this Net-work, which appears white, another is seen somewhat red, and under this a Third and a Fourth, still deeper coloured: In fine, the Ground under all these reticular *Strata* is of a very deep Red; and the Whole may be justly enough compared to a Piece of Wood stripped of its Bark. It is probable, that this sort of Injection, made by the way of Digestion, might lead an able Anatomist to some very useful Discoveries on the Nature and Formation of the Bones. Nay, I think I have already found out something new on this Head; but, as I have still some Scruple remaining on my Observations, I will not venture to communicate the Consequences drawn from them.

In order that the *Madder* should produce the above related Effect on the Bones, its Tincture must have such a Degree of Fixity, (according to the Dyers Term) as not to be changed by the dissolving Action of the *Saliva*, of the Juice of the Stomach, of the pancreatic Juice, of the Bile, &c. nor by the peristaltic Motion of the Stomach and Intestines; and yet these Juices act so powerfully on common Aliments, that after Digestion they are not to be known either by their Smell, Taste or Colour. This is not all: These colouring Particles must be small enough to pass with the Chyle into the Blood, and circulate with it through a great Number of Strainers or Vessels, without being separated, and without being deposited either in the Liver, Spleen, or Pancreas.

I strongly suspect that Portion of the Lymph of the Blood, which is fit for nourishing the Bones, might
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be the true Diffolvent of the Tincture of the *Madder*, and might convey it to the Place whither it carries Nourishment to the solid Parts of the Body of these Animals. In consequence of this Conjecture, which I shall resume in the Sequel, I thought that the Skeletons of young Animals ought to take a stronger and quicker Tincture, than those of full-grown Animals; because the Bones of young Animals are in a State of Growth, which requires a greater Quantity of osseous Juice. It is likewise true, as above said, that it is the hardest Bones of young Animals, that imbibe most of the Colour. All these Considerations gave Rise to a Difficulty, which was to be cleared up.

Wherefore, in the Beginning of last *October*, I chose Two Turkeys of the Year, the strongest I could find, and young Pigeons in their first Hair or Down. I could wish to have made the Experiment on Animals of the same Species; but it was impossible to find young Turkeys in their first Down at that Time of the Year: And besides, these Animals being extremely tender during the first Months, their Stomach would never have been able to bear the Effect of the *Madder*. As to old Pigeons, I had no tame ones: The wild are difficult to be fed with the Paste; and if they were suffered to feed at Discretion, they would not have been sufficiently *maddered*, if I may be allowed this Expression. However, the Bones of my Two Turkeys were very hard, in comparison of those of the young Pigeons: And thus I had in these Animals, though of different Kinds, all that was of Importance for my Experiment.

My young Pigeons, fed with the Paffe mixed with *Madder*, died the Third Day; yet all that had the Consistence of Bone in their Skeletons, was become as red as Scarlet. Mr. *Belkier* was surpris'd to see the Bones of his Cock tinged red in Sixteen Days, and here are Bones so coloured in Three Days. But all that should in Course of Time have turned to Bone in One of my young Pigeons, and as yet was but Cartilage, as the *Epiphyses*, the great *Apo-physis* of the *Sternum*, &c. had not taken the least Colour. In the other, there were some Spots of a very weak red on the Cartilage of the *Sternum*, which probably began to ossify. Other Experiments, since tried, have taught me with greater Certainty, that the Cartilages in general are not tinged red by the *Madder*, but when they begin to acquire the Consistence of Bone.

If, as I suspect, it is the lymphatic Part of the Blood that is the *Menstruum* of the colouring Particles of the *Madder*; if this Lymph contains the nutritious Juice of the Cartilages and Bones; why does it not, in carrying with it the colouring Particles it has extracted from the Root, why does it not, I say, tinge the Cartilages as well as the Bones? In my Opinion this Difficulty cannot be solved but by the Difference of the Pores. In the Cartilages they are too large, the colouring Matter passes through them too easily, and finding no ossious *Laminæ* yet formed, for want of a Surface sufficiently extended to retain it, it passes with the superabundant Lymph through the Pores of the Cartilages. When these Cartilages begin to take a proper Consistence, where there are *Strata* of ossious *Laminæ* already formed, the Ob-
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stacle exists, the colouring *Fæcula* is detained and deposited there. When the ossifying Juice is no longer necessary for repairing a daily Loss of Substance, as in Animals arrived at their full Growth; besides that probably this Juice is then much less abundant, and consequently, in proportion, less charged with the colouring Parts of the Root; it must necessarily result thence, that the Bones of an adult Animal will be much weaker coloured. And this is what happened to my Two Turkeys, which, though fed for Fifteen Days with the Paste of Meal and *Madder*, had their Bones tinged but of a Rose Colour, which appeared to me somewhat deeper towards the Ends than the Middle, which, having too much Consistence, could not admit or retain the same Quantity of the colouring *Fæcula* as the tender Bones of the young Pigeons. Therefore the Bones of Animals that are still growing, are dyed better and quicker than those of full-grown Animals; and, in my Opinion, for the Reasons already given. My Two Turkeys had the same Ailments with the Pullets of the First Experiment, they fell into a Decay like those, and I was obliged to have them killed in Fifteen Days time.

Here we see young Pigeons, whose Bones were dyed of a fine Carmine-red in three Days; which is nearly the Time they must have for acquiring this Degree of Tincture. By other Experiments on young Pigeons of the same Age, I have found, that in Thirty-six Hours their Bones were of a lively Rose-colour, and in Twenty-four Hours they were at least of a Flesh-colour.

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These last Experiments prove with what Expedition the Distribution of the nutritious Juice is performed in Animals of this kind, which acquire all their Growth in a few Months; and how rapid the Distribution is, even in those Parts where the Blood's Circulation meets with the greatest Obstacle, as in the Substance of the Bones.

As one ought likewise to infer from these Experiments, that there are vegetable Medicines whose chief Tendency is to the Bones, and which consequently might remedy many of their Distempers, I looked on myself obliged to employ the *Madder* with this View; but not having it in my Power to raise Diseases of different kinds in the Bones of my Animals, I confined myself to the Examination of what Effect it would have in a Fracture.

I chose Four very vigorous young Pigeons: A Thigh-bone of each of them was broke; the Reduction was immediately performed, and secured by a proper Bandage. Two of these Pigeons were fed with the Meal and *Madder*, and the other Two with the Meal alone. These last, notwithstanding the Pain the Fracture must have given them, had always a good Appetite, and in Eight Days they began to walk with their Dressing, which was a little loosened. The others fell into the Accidents already mentioned, and died, one on the Tenth, the other on the Fourteenth Day. The Two Pigeons that had recovered were killed, in order to compare the *Callus*.

That of the Pigeons which had not taken any *Madder*, was little, close, and very even: That of those fed with this Root, was large, spongy, and uneven: There shot out of it a sort of Vegetation: It

broke between the Fingers, and crumbled into small Grains. It is true, that the State of Suffering of these Animals, occasioned by the Hurt, and increased by a Food improper for them, might retard the perfect Reunion of their Bones; yet I think, it certainly results from this Experiment, and others which I suppress, because they prove nothing more, that the *Rubia Tinctorum*, taken inwardly, is rather prejudicial than beneficial in the Case of Fractures; and it is not without its Use to know what is to be avoided.

The *Rubia*, probably, is not the only vegetable Substance that can change the Colour of the Bones; and yet I have tried the Log-wood, the *Anchusa* and *Curcuma*, without Success. In all Likelihood, it must be a Substance less susceptible of Alteration; and it is well known, that the *Rubia* is of that sort, seeing the Cloths dyed with this Root bear very well the Action of the Air, and that of boiling.

I have put the coloured Bones of my Animals to several Proofs: First, as Mr. *Belchier*, to that of boiling Water, and of Spirit of Wine, without the least Change of Colour. It also resisted Soap-suds. A strong Lixivium of Salt of Tartar discharged a little of the Colour, and made it look brighter. Vinegar made it take a yellowish brown and obscure Tinge. In fine, Alum-water discharged the Colour pretty considerably, and the Water remained somewhat vinous. Thus these Bones perfectly well resist the same Boilings as the Cloths dyed with the same Root; but the Air acts upon them much sooner than on these Cloths: For the Bones of the Pullets in the First Experiment, those of the Turkeys in the Third, and those of the young Pigeons, that had eat of the

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Madder but Three Days, became intirely white in less than a Year; and the reddest Bones lost much of their Colour. And I am of Opinion, that the Dew, to which I have exposed some of them for a few Days, will finish the Whitening of them.

As there is a sort of Analogy between the Nutrition of Animals and that of Vegetables, I have not neglected trying, if the Tincture of the *Rubia* would introduce itself into the Vessels of some Plants; which would, perhaps, contribute much to lay open their Organization.

For the First Experiment, in which indeed I had no Hopes of Success, I planted Two Bulbs of *Tuberoses* in Earth, with which I had mixed a good Quantity of *Madder*: But I found nothing, either in the Leaves, Stalk, or Flowers, but what was in the common and natural State. And this must have been so: For since it is only the Bones that take the Tincture in Animals, the *Tuberoſe*, having all its Parts soft, is in the State of an Animal without Bones: Such as a Leach, an Earth-worm, a Lamprey, which would probably continue in their natural State, whatever Quantity of *Madder* were given them, supposing it could possibly be done.

Wherefore I resolved to try the Experiment on a Tree. I planted a Paradise Apple-tree in a Box, which I had filled with Earth mixed with a great deal of *Madder*; and I covered the Upper Surface of the Earth with a Layer of *Madder* Two Inches thick. This Layer was renewed several times for near Two Years that my Tree is under the Experiment; but I have not as yet been able to examine if its Wood is coloured by this Root. In case the Experiment

does not succeed, as it is very likely it will not, it will serve at least to expose the Vanity and Uselessness of all those Receipts and Processes of Vegetation, that are to be found printed in *Mizzaldus*, *Porta*, and other more modern foreign Compilers.

V. *A Catalogue of the FIFTY PLANTS from Chelsea Garden, presented to the ROYAL SOCIETY by the Company of Apothecaries, for the Year 1739. pursuant to the Direction of Sir Hans Sloane, Bart. Med. Reg. & Soc. Reg. Præf. By Isaac Rand, Apothecary, F. R. S. Hort. Chel. Præf. ac Prælec. Botan.*

851. **A** Carna major; caule folioso. C. B. 379.
 852. **A** Astragalus, perennis hirsutus, Alopecuroides; Galegæ foliis; floribus luteis.
 853. Bauhinia non aculeata; folio subrotundo, bicorni; floribus albis. D. Houston.
 854. Bidens Americana; flore albo radiato; foliis inferioribus trilobatis; superioribus subrotundis, acute crenatis.
 855. Bidens latifolia, hirsutior; semine angustiore, radiato. H. Elt. P. 51.
 856. Bidens scabra; flore niveo; folio Panduræformi. Ibid. P. 54.
 857. Bignonia Americana; Fraxini folio; flore amplo phœniceo. T. 164.

858. *Bignonia Americana*; Fraxini folio, minor; flore coccineo.
859. *Calendula*, minor, arvensis. H. L. Bat.
860. *Camara*, Americana; *Urticæ* foliis, latioribus, spinosa; floribus miniatis.
861. *Camara*, Americana; *Urticæ* folio; floribus miniatis.
862. *Camara*, Americana; *Urticæ* foliis minoribus; flore vario.
863. *Camara Americana*; foliis parvis subrotundis; floribus, foliolis interceptis.
864. *Camara Americana*; *salviæ* foliis, mucronatis; floribus luteis.
865. *Caprifolium Germanicum*. Dod. 411.
866. *Chenopodio-morus media*; foliis argute dentatis.
867. *Chenopodium*; *Botryos* folio, subtus candicante.
Atriplex sylvestris. II. Tab. Icon. 407.
868. *Chenopodium*; folio laciniato majus.
Pes Anserinus. Fuschii.
869. *Chenopodium*; folio sinuato, candicante. T. 506.
Atriplex sylvestris. Tab. Icon. 406.
870. *Chondrilla*; *Sonchi* folio; flore luteo-pallescente. T. 475.
871. *Cirsium*, arvense repens; folio vix sinuato, in aculeum abeunte.
872. *Cruciata nova*, Romana, minima, muralis. Col. Ecph. 295.
873. *Cynoglossum*, Virginianum; flore minimo, albo. Banisteri. Pluk. Alm. 126.
874. *Eryngium maritimum*. C. B. 386.

875. *Eryngium vulgare*. Ibid.
Eryngium campestre. Dod. 730.
876. *Jacobæa*; foliis ferulaceis.
877. *Lappa*; sive *Bardana major*; flore albo. H.
Ox. III. 147.
878. *Lappa major*, ex omni parte minor; capitulis
parvis eleganter reticulatis. Pluck. Alm.
879. *Lilac*; *Ligustri folio*. T. 62.
880. *Lyfimachia annua*, minima; *Polygoni folio*.
T. 142.
881. *Mentha*, angustifolia, spicata. C. B. 227.
882. *Mentha*, angustifolia altera, rugosior; spica hir-
suta.
883. *Mentha*, verticillata; longiori acuminato folio;
odore aromatico.
884. *Oldenlandia*, humilis, *Hyssopifolia*. Plum.
N. G. 42.
885. *Oxys*, lutea, Americana, procumbens.
886. *Pervinca vulgaris*, angustifolia. T. 120.
887. *Petasites major*, & vulgaris. C. B. 197.
888. *Petasites major*; floribus albis; spica bipedali.
D. Bobart.
Petasites major; floribus pediculis longis
insidentibus. R. Syn. III. 179.
889. *Petasites minor*; folio *Tussilaginis*. Mor. H.
Reg. Blef.
890. *Phlomis*; acuminato, viridi, splendente folio;
flore purpurascente; caulibus villosis.
891. *Phlomis*, Hispanica, fruticosa, candidissima;
flore ferrugineo. T. 178.
892. *Phlomis Narbonensis*; *Hormini folio*; flore
purpurascente. Ibid.

893. *Phytolacca*; fructu monopyreno, majore; folio longiore, glabro.
894. *Pilosella*, major, umbellifera, macrocaulos. *Floribus est flosculosis*. Col. Ecph. 248.
895. *Rosa*; *Pimpinellæ* folio, Scotica; flore eleganter variegato.
Rosa Ciphiana. Sibald. Scot. Illust.
896. *Rosa sylvestris*, Virginienfis.
897. *Senecio Americanus*; folio hastato, nitide serrato.
898. *Sium umbellatum*, repens. Ger. Emac. 256.
899. *Solanum*, fruticosum, Africanum; Lauri foliis.
900. *Vulneraria erecta* annua; folio subrotundo leviter crenato.
Loto affinis, *Coryli folio*. Dod. Mem.

VI. *A Physico-mathematical Demonstration of the Impossibility and Insufficiency of Vortices: By M. de Sigorgne. Translated from the French by T. S. M. D. F. R. S.*

THAT natural Philosophers of an inferior Class, who consider only the Outside of Things, are obstinate in the Defence of *Vortices*, is, in my Opinion, not to be wondered at: The Idea of them strikes the Mind very agreeably at first, and even seems to promise the true Mechanism. But that Persons versed in the most profound Geometry, and in the most sublime Calculations, able Academicians, who incessantly apply themselves to the Study of
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Nature, should plunge headlong into these Notions, and sustain the *Vortices pro aris & focis*, is to me Matter of unaccountable Surprize.

It appears to me, that a *Vortex* is as shocking upon mature Consideration, as its Idea is satisfactory upon the first mentioning it. And *Vortices*, in my Opinion, are like smart Sayings (*bons mots*), which charm the Mind the first, or, perhaps, the second time, but by a Repetition become quite flat and insipid. What Man, indeed, (if free from Prejudice, and that the Spirit of Party has not depraved his Judgment) would not be astonished to see brought on the Scene, not only *Vortices*, but such as are composed of an infinite Number of smaller *Vortices*, each of which still contains an innumerable Number of others subordinate to them? For Example: What is this Air, this Water, this Oil, &c. which Monsieur *de Moliers* takes pains to introduce? A Sport of the Imagination, or of the Mind, if you please; but in reality a Paper-building. It has been long since said, that according as *Vortices* shall be multiplied, they will degenerate into Littleness and Puerility: And these are the Sentiments even of the good *Cartesians* of our Days. But might it not be said, that the great *Vortices* having the same Origin with the little, the latter shew the Meanness of Extraction of the former? As Matter is divisible *in infinitum*; as to Vorticity, there is no Difference between the Great and the Small: And consequently, we have a Right to reject the large *Vortices*, since *Cartesians* proscribe the small.

It is on this Consideration that I am resolved to attack the *Vortices*: For I must own, to the Shame
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of our Nation, that the Spirit of Party is so predominant therein, that several Persons, who by a close Study have found the Insufficiency of *Vortices* for explaining the *Phænomena* of the Heavens, yet have not dared to publish their Notions on that Subject.

But as at present the System of small *Vortices* is freely attacked, I think, as already said, that I have a Right to attack the large; and to this Purpose I hope to prove,

I. That the mechanical Formation of a *Vortex* is impossible.

II. That the *Vortex*, were it formed, cannot be of long Duration.

III. In fine, that it is not sufficient for explaining the *Phænomena*.

FIRST PART.

The mechanical Generation of the Vortex is impossible.

DEMONSTRATION.

In the Hypothesis of a perfect *Plenum*, GOD at first created Matter indefinite, uniform, homogeneous, and at Rest. This is allowed by all *Cartesians*, and follows in their Principles from this alone, that Matter was created at Rest. Now, from this perfect Homogeneity of Matter it evidently results, in my Opinion, that the *Vortex* cannot be mechanically formed. Suppose, say the *Cartesians*, that while Matter is as yet at Rest, GOD imprints a Motion in a strait Line on one of its Particles: This Particle will every Instant meet with Obstacles to the recti-

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linear

linear Motion in the encompassing Matter; this Motion must therefore be turned aside, and will by this means become circular.

But why should the encompassing Matter, which is at Rest, be an Obstacle to the rectilinear Motion? Because, say they, it happens to be in the Line described by the Particle, on which Motion is supposed to be imprinted. But this very Reason would also prove, that the Body supposed to be in Motion could not circulate round a Centre at a Distance from it; because it would constantly meet with Matter at Rest in the Sides of the Polygon which it was to have described.

In a Word, it is a received Principle, that a Body which moves in a homogeneous Medium, never quits the Line of its first Direction: It does not refract, or deviate on one Side or the other of this Direction, except when it passes from an easier into a more difficult Medium, or from a denser into a less dense Medium: and even then its Direction must be oblique on the Surface of this Medium.

Now, the Body in Question would move in a Medium intirely homogeneous; seeing all the created Matter is supposed to be so, and that all but one Particle of this Matter is at Rest. It is moreover evident, that as all the Matter is uniform, every Direction, of what kind soever, of a Body which moves in the midst of this Matter, will be perpendicular to the Surface which corresponds to it; as is demonstrated in Mechanics. The supposed *Mobile* will therefore always move in the Line of its first Direction, until it has communicated all its Force; or rather it will
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remain at Rest after the least Shock, if Regard be had to nothing more than what I have hitherto said.

But there still remains a very important Remark to be made on this Subject, to wit, that as it is universally agreed at this Day, that Rest is not a Force, all this Matter created at Rest will be infinitely soft: Its Parts will have no Tenacity, no Connexion, no Viscosity; they will be but contiguous, and will not have more Adhesion to one another, than Two Globes which would touch out of the Bounds of the World without any reciprocal Attraction; since Tenacity, Viscosity, &c. are in the *Cartesian* System but the Effects of Compression every Way. Wherefore these Parts will be divided at the least Shock, in the same manner as if Quicksilver be thrown against a Wall, it is instantly seen to be divided into a Million of Parts, to be reflected on every Side, and be again divided as soon as it falls on the Floor. I know my Comparison is not exact, but the Advantage is on my Side; because Quicksilver is not without Viscosity, or a certain Tenacity between its Parts; whether it proceeds from Attraction, which is my Opinion, or that it be the Effect of the Pressure of the ambient Fluid. Therefore the *Cartesian* Matter will have more Facility to divide than Quicksilver, and will not be susceptible of any regular Motion; which alone demonstrates, that the mechanical Generation of the *Vortex* is impossible.

There is however this Difference between the *Vortex* imagined by *Descartes*, composed of hard Globules; and that of the infinitely soft Matter of Father *Malebranche*, whose System is revived by his Disciple Monsieur *de Molières*; that if the *Cartesians*

admitted Gravity as a Principle; besides that it would give the true Cause of Hardness, its Combination with the strait or projectile Motion would produce a Motion in a Curve; as Sir *Isaac Newton* has demonstrated. But until they will return to this Idea of primitive Gravity, and further while they will make use of no other Matter than one infinitely soft, and really unintelligible, it will not be possible to conceive a single *Vortex* formed; far from having this infinite Number, which, by-the-bye, ought to be dissipated as Waves raised in the Water, upon account of their perfect Homogeneity.

The famous *Cartesians*, always refusing to allow this primitive Gravity, and at the same time plainly seeing, that this first Manner of forming the *Vortex* was impossible, have had recourse, in order to its Formation, to the Motion of Rotation of a solid Sphere at the Centre of a small Particle of Matter at Rest, &c. and they have pretended, that this Sphere in its Circulation ought to carry along with it the circumambient Matter.

But this Notion is certainly as unsustainable as the First. For,

1st, They must explain to us the mechanical Formation of this Sphere; they must account for its Solidity: But all this manifestly supposes the *Vortex* already formed; all this supposes a Pressure equal on every Side, uniform and concentric.

2^{dly}, This Sphere would never imprint an equal Velocity on all the Points of the concave Surface which touches and incloses it, seeing itself has not an equal Velocity in every Point of its last Surface; and therefore the *Vortex* would not have as much
Force

Force to defend itself towards the Poles, as towards the Equator; as we shall shew hereafter.

3^{dly}, This Sphere, in striking against the ambient Matter, would but divide it *ad infinitum*; because it is infinitely soft, and that its Parts have no Adherence with each other.

4^{thly}, It is not sufficient, that a Sphere turns round its Centre, to draw into its Circulation the ambient Matter: It is moreover requisite, that to press on this Matter in a Direction from the Centre to the Circumference, (which a solid Globe either cannot do, or can hardly be conceived possible for it to do) and further still, it is necessary there should be Unevennesses on this Sphere, and on the concave Surface of the ambient Matter; because otherwise, though the Sphere should press this Surface by its centrifugal Force, it would only raise it up, or tend to raise it, and it would slide along the Surface without dragging it away with it: On which Head there is this Particularity to be remarked, that, for the uniform Circulation and Conservation of the *Vortex*, and still more for the preserving of *Kepler's* Laws, the Spheres and Surfaces must be strictly Mathematical, as we shall soon see; and for its Formation they must be rough, and full of Unevennesses: But what can be more whimsical? And further, though these Surfaces were full of Prickles, yet could not the *Vortex* be formed in the Hypothesis of Father *Malebranche's* soft Matter; because the Parts which would form these Eminences and Unevennesses on the concave Surface of the Matter surrounding the Sphere, not being connected with the other Parts of the same Matter, would be carried off without Difficulty by the Rotation of
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the Sphere; and the rest of the Matter would remain at Rest. And those who would pretend, that these Unevennesses, these Parts which form the Hillocks we are speaking of, could not, in consequence of God's Decree, loose themselves from the other Parts of the Matter, would evidently abandon Mechanism, without reaping any Advantage: Because, supposing it true, that by this Means the ambient Matter would be compelled to circulate, yet could it not form a fluid *Vortex*, wherein *Kepler's* Laws could be observed; because both the Sphere and these Surfaces being by these Unevennesses wedged into each other by solid hard and inflexible Parts, they would necessarily move all of a Piece, as the Parts of a Sphere do.

sthly, By means of this Sphere one could have but a great *Vortex* formed; and not that infinite Multitude of small *Vortices*, with which the great ones are at this Day supposed to be filled, and in the Centre of all, or most Part of which, People will not allow that there are hard Globules, and so of the rest: For I am persuaded, that the Reader, by a little Meditation on this Subject, will find almost as many Reasons against this System, as there are small *Vortices* supposed to exist.

It may be objected, that we do not pretend to form a *Vortex*: We suppose that God formed it in the Beginning, and in Consequence hereof we account for its Properties and Conservation.

But, besides that the Impossibility of the mechanical Generation of a *Vortex* is a strong Prejudice against its Conservation; I pretend, in the Principles
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of our Adversaries, GOD could not form a single *Vortex*.

I desire Attention may be given, that a circular Motion is a redoubled and forced Motion; and not, as Mr. *Perault* thought, a natural Motion. Now the rectilinear Motion cannot be redoubled thus, as against its Nature, in order to become circular, but upon a Supposition that it meets in the ambient Matter invincible Obstacles to its Direction; or that by a primitive Law it is carried towards a Centre by a Motion of Gravitation, at the same time that it receives a Motion in a strait Line. Therefore, since on one hand this universal and primordial Gravity is obstinately rejected; and on the other, as it is solidly proved above, that the ambient Matter is no Obstacle to the rectilinear Motion; it remains certain, that the Formation of the *Vortex* is impossible. Q. E. D.

SECOND and THIRD PART.

The Vortex, though once formed, cannot last, and it is not sufficient for explaining the celestial Phenomena.

P O S T U L A T U M.

The cylindric *Vortex* cannot long subsist, and is not sufficient for explaining the celestial *Phænomena*: This Principle is allowed by all *Cartesians* in both its Parts. It cannot subsist; because not having Force to defend itself towards the Poles, if it happened to hit on that Side against another cylindric *Vortex*, that presented its Equator, it would soon be broke into,
and

and burst to its very Centre. If, on the contrary, its same Side touched another cylindric *Vortex* by the Poles, they would both mix together, and would compose but one *Vortex*.

It is not sufficient for explaining the celestial *Phænomena*; because it is allowed, that the translative Velocities of its Points cannot be in an inverted *Ratio* to the Roots of the Distances, and that its centrifugal Force does not diminish in the inverted *Ratio* of the Squares of these Distances, &c.

C O R O L L A R Y.

Therefore the spherical *Vortex*, in order to be of Use, must have other Properties than the cylindric: That is to say, it must have a relative Force to one and the same Centre; for it is by this Force alone that it can be different from the cylindric *Vortex*.

This Force, moreover, must be equal in all the Points of the same spherical Superficies; because otherwise it might be burst and broke into in its weak Parts, as well as the cylindric, &c.

T H E O R E M I.

Even in the spherical *Vortex* there is no relative Force to one and the same Centre: That is to say, that it has properly but an axifugal Force.

D E M O N S T R A T I O N.

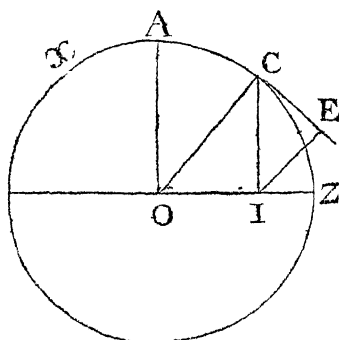
The spherical *Vortex* is composed, as well as the cylindrical, of several parallel Circles, but with this Difference, that in the spherical *Vortex* the *Radii* of the parallel Circles are not all equal, but on the contrary

trary diminish according as they recede from the Equator, and approach the Poles. Now it is manifest, that all the parallel Circles circulating round different Points of the Axis in the spherical *Vortex*, as well as in the cylindrical, tend to recede only from these different Points of the Axis, round which they circulate; because a Body cannot tend to recede from any Centre but that of its Circulation. In a Word, in order to make a *Vortex* spherical, which was cylindrical, they have but proportionally shortened the parallel Circles. But let the *Radius* of a Circle be ever so much shortened or lengthened, that will not change the Direction of its dilatative Effort. I am mistaken! an imaginary Line is going to change the Direction of the axifugal Force. This Force, as all agree, has for its Direction the *Radius* IC, in the Circumference whereof it is the *Radius*; but the Direction IC is oblique to CE the Tangent to the Sphere; therefore it changes, according to the general Law of an oblique Shock, into the Determination IE or OC relative to the Centre O.

But if Lines may be imagined, and that nothing more is requisite to realize them, than Points that correspond to them; we shall have some of all sorts in the *Vortex*: We shall have oblique Lines on the *Radius* OA, a perpendicular one, and some more or less oblique, on the *Radius* IC, and by that means we shall be able to determine nothing. Let us grant however, that there is a Tangent to the Sphere CE, at the Point C, and let us see if it will be a sufficient Reason for decomposing the centrifugal Force IC into a central Force IE or OC. For that Purpose I ask, What are the Points that compose this Tangent?

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gent? It is evident, that it can only be the Globules of the upper *Stratum* that answer thereto. The Line CE is therefore composed only of a certain Number of Points separate one from the other, and which consequently can move one without the other. Therefore if the Line IC is perpendicular to the Globule that occupies the Point C, and that it passes through its Centre; there will be no Decomposure, and the Force IC will not change into a Force that has the *Radius* OC for its Direction.

Now it is infinitely probable, that the *Radius* IC passes through the Centre of the Globule C; and it is easy to demonstrate, that it is actually so even in the Principles of Monsieur *Saurin*, who first invented this central Decomposition. For what has been the Cause of the Decomposition of the circular Velocity into the centrifugal Force IC? It seems plain to me, that no other Cause can be assigned than the Point or Globule C; seeing there is but that one at the Point where it happened. The Line IC passes then through the Centre of the Globule C; since the
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Decomposition is always made in a perpendicular Line to the Point that caused it.

And indeed, either the *Radius* IC passes through the Centre of the Globule C, or the Centre of this Globule is on one Side or the other of this *Radius*, but so as that this *Radius* cuts the Point C; or else, it is a Space intercepted between Two Globules, which directly answers to the Point C. In the First Case, there is no Decomposition: In the Second, and in the Hypothesis, that the Centre of the Globule C happens to be between the *Radius* IC and the Equator, there will be a Decomposition; but it is manifest, that it will not be a central one: It will, on the contrary, be relative either to the very Pole, or to one of the polar Circles. In the Third Case, wherein it is supposed, that it is a Space intercepted between Two Globules, which answers to the Point C; there may be a Decomposition, but it will be double, the one relative to the Centre O, and the other relative to the Pole Z.

Now the *Cartesians* can never draw from this Decomposition the Advantage they propose; because there will not be more Reason for heavy Bodies precipitating to the Centre of the Sphere by means of the central Force, than to the very Pole by the Assistance of the polifugal Force; or rather, the Complication of these Two Forces will compel the *Mobile* to precipitate to the Centre I of the Parallel it happens to be in.

Wherefore, in order to defend the spherical *Vortex*, they must say, that the Centre of the Globule C is comprehended between the Poles and the *Radius* IC. But on what Foundation will they assure it?

What are the Proofs they will give for it? One must certainly be a very bold Gamester, to hazard this Point; because besides the Appearance of Truth, the Adversaries of *Vortexes* may wager Three to One, that it does not so happen. But in case it be allowed, will they ever find in the soft Matter of Father *Malebranche* and Monsieur *de Moliere*, a sufficient Cause of the Decomposition? There must be a Resistance to produce a Decomposition, and an infinitely soft Matter does not resist. And further, in the Hypothesis of the Decomposition of IC or OC, the *Vortex* would not be in Safety; because there would be a Remainder of the centrifugal Force IC, that would be parallel to the Tangent CE, and would evidently spread Confusion in the *Vortex*, by driving all the parallel Circles towards the Equator.

This seems to me sufficient to discredit, in the Minds of rational People free from Prejudice, this central Force, which is attempted by all means to be introduced. But let us not be tired of examining this Point thoroughly: It is of Consequence, and the *Cartesians* well deserve the Trouble of an abundant Refutation. Wherefore let us suppose, that GOD forms a *Vortex* cylindrical and fluid; it is a received and evident Principle, that its Points will have but an axifugal Force. And if a Sphere be conceived to be inscribed in this Cylinder, the Points that compose it, will not in like manner have any central centrifugal Force, according to the Axiom: *Nostrum intelligere nihil ponit in re*. Now let us realize this spherical *Vortex*, which before we had but conceived; that is, let us suppose, that GOD has destroyed the translative Velocity of the Points that form the

angular Spaces intercepted between the last Surface of the inscribed Sphere and that of the Cylinder; it is manifest, that no Change will happen in the Velocity and axifugal Force of the rest of the Points, which are not included in these; for this Reason, that the Points which fill the Two kinds of Basins that mark the Excess of the Cylinder above the inscribed Sphere, remain in the same Order, Disposition, and Direction, with regard to the inferior Points, which they were in at the time of their Motion. And there is no other Difference to be perceived herein, except that at present it is the same Point that constantly corresponds to the same Place; and that before this Place was successively occupied by Points intirely resembling each other, and that which remains or is supposed constantly to remain therein.

Now whether this Place be constantly occupied by one and the same Point, or successively by Points intirely alike and in the same Order, is what ought not to produce any Variation in the Effect which we are examining: And this appears to me at least as clear as Noon-day.

Wherefore, since these inferior Points had then but an axifugal Force, it follows that even now they have no other Tendency than to recede from the Centres of their Circulations, without having any Force relative to the Centre of the *Vortex*.

This is all that pure Reason dictates to me on this Point of the Nature of the *Vortex*, whether spherical or cylindrical: And I dare flatter myself, that whosoever will attentively examine my Reasonings, will find

find them as demonstrative as can be desired in Natural Philosophy.

In Effect, Experience agrees here with Reason. If a glass Globe filled with Water be rapidly turned on its Axis, one sees little Foulnesses; the small Atoms which it never fails to contain, gather together along the Axis, and form a little Cylinder round it.—Which very plainly shews, that in this spherical *Vortex* of Water there is but an axifugal Force.
Q. E. D.

C O R O L L A R Y.

Therefore Gravity is inexplicable in the *Vortex*, and it has not Strength to defend itself towards the Poles.

T H E O R E M II.

Supposing there was in the spherical *Vortex* a central Force according to the *Radius* OC , it could not by Reaction be changed into a centripetal Force according to the *Radius* CO .

This Proposition is well known to all who are somewhat conversant in Mechanics.

It is therein demonstrated, that if the *Radius* IC , for Example, forms with the Tangent CE an Angle of 45 Degrees, the Line of Reflexion will be parallel to the Axis; and that from the Point C to the Pole Z , the Lines of Reflexion will be divergent to the Axis; and, in fine, that from the Point C to the Equator, these same Lines of Reflexion will be indeed convergent to the Axis, but will never terminate at the Centre O : In a word, that because the Angle of Reflexion is always equal to the Angle
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of Incidence, it is only at the Equator that the centrifugal Force can be changed into a centripetal Force.
Q. E. D.

C O R O L L A R Y I.

Therefore the modern *Cartesians* are strangely mistaken, when they pretend to account for Gravity by the Reverse of the central centrifugal Force.

C O R O L L A R Y II.

And they can never, *à fortiori*, in their Principles, explain the Figure of the Earth and of *Jupiter*, which are flatted Spheroids made by the Conversion of an Ellipsis upon its small Axis.

L E M M A I.

If the centrifugal Force represented by IC (see p. 420.) be decomposed on the spherical Tangent into a Force, that for its Direction has the Centre of the Sphere; the central Force, which results from this Decomposition, will be to the centrifugal Force, as the *Radius* IC to the *Radius* OC.

For the centrifugal Force IC, being decomposed into C on the Tangent of the Sphere, will strike this Tangent with a Force that will be represented by IE. But on account of the similar Triangles IEC, IOC; IE. IC :: IC. OC.

L E M M A II.

A Body which describes a Curve, strikes this Curve every time it passes from one Side to the other, with an infinitely small Force of the first kind with regard to its Velocity.

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To the best of my Remembrance, this Proposition is demonstrated in Dr. *Clarke's* Notes on *Robault's Physica*, and in Monsieur *de Moliere's* Lectures: And it is evident from this alone, that it can only be by a Force represented by the Sine of the Angle of Contact that this moveable Body strikes the Tangent of its Curve.

THEOREM III.

Let us put Complaisance on the Stretch, and grant that *Vortexes* have a central and centripetal Force relative to one Centre O: I say, that the spherical *Vortex* will not have as much of this central Force, to defend itself towards the Poles, as towards the Equator.

CONSTRUCTION:

Let us take, in the same Superficies X (see the Fig. p. 420.) Two Points at Pleasure, the Point A in the Circumference of the Equator, and the Point C in the Circumference of a subduple parallel Circle; we will give in the Demonstration an equal Velocity to the Globules which circulate in these Two Circumferences; which is the most favourable Concession imaginable for the Patrons of *Vortexes*.

DEMONSTRATION.

It is manifest, that if the Point A is in an equal Space of Time struck an equal Number of Times as the Point C, and that each Stroke against the Point A be double each Stroke against the Point C; it is manifest, I say, that there is more Force at the
Equator

Equator than at the parallel Circle. Now the Supposition is very certain in both its Parts: For,

1. Since the Circumference of the Equator is the double of that of the parallel Circle, and that being at an equal Distance from the Centre O, (see Fig. p. 420.) the Globules they contain are equal to each other; if there be a Thousand Globules in the Circumference of the Parallel, there will be Two thousand in the Circumference of the Equator. And as these Globules are supposed to have in both an equal Velocity, they will make (but) One Revolution in the Equator, while those of the subduple Circumference will make Two. Therefore, in both, there will be Two thousand Strokes employed in the same Space of Time, against the Points A and C.

2. Each central Stroke is double at the Equator: Because, as there is in both an equal Velocity, and that (LEM. II.) each centrifugal Stroke in every Circumference is a Fluxion of the first kind, with regard to the Velocity of the Globule which is in Motion; it follows that the centrifugal Strokes both in the Equator, and in the parallel Circle, are equal to each other. But the central Effort (which is the only one by which a *Vortex* can defend itself towards the Poles) is at the Point C (LEM. I.) but half the centrifugal Effort, since it is represented by IE subduple of IC; whereas at the Equator the central Effort is the same with the centrifugal Effort, because the *Radius* OA is perpendicular on the spirical Tangent, which corresponds to it. Therefore, &c.
Q. E. D.

COROLLARY I.

Therefore if a *Vortex* be in *Equilibrium* with another *Vortex*, and that the Equator of one happens to answer to the Poles or Tropics of the other; the latter will be burst and penetrated to the Centre: And I do not think, that the *Cartesians* can find their Account in this Consequence.

COROLLARY II.

Therefore if the *Vortex* was the mechanical Cause of Gravity, Gravity ought to be greater at the Equator than at the Poles; and the Earth would be an oblong Spheroid; which is contrary to Observations.

REMARK.

I have said, that it was making a large Concession to the *Cartesians*, to suppose that the Globules of both the Circumferences have an equal Velocity. For if a Sphere full of Water be made to turn on its Centre, Experience teaches, that the Velocity is greater at the Equator than in the parallel Circles; since it is observed, that the Times of their periodical Revolutions are equal. Whence it follows, that I have, in my Demonstration, made the most favourable Supposition for the *Cartesians* that was possible.

THEOREM IV.

In order to determine the Tendency of a Layer towards the Upper Part of the *Vortex*, regard must be had not only to that which results from its own Circulation, but also to that which it receives from
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the other lower Layers, unless it be the Layer next the Centre.

DEMONSTRATION.

While a Layer is in Circulation, it visibly makes a continual Effort towards dilating itself, by reason of the centrifugal Force, with which all its Parts endeavour to recede from the Centre of Circulation: But its actual Dilatation being impeded by the Layer next above it, this last will be naturally pressed by it. And thus it is that the first or lowest Layer, being put into Circulation, presses the Second; and the Second, assisted by the First, presses the Third; this, assisted by the Two preceding, presses the Fourth; and so on from Layer to Layer, through the whole Extent of the *Vortex*. Whence it follows, that in order to estimate the Quantity of Force with which a Layer tends towards the Surface of the *Vortex*, one must take the centrifugal Force proper to this Layer and that, which all the Matter of the Fluid contained under it acquires by Circulation. *Q. E. D.*

COROLLARY I.

Therefore the dilatative Effort of the Layers increases with the Layers in a greater Proportion than these Layers.

COROLLARY II.

Therefore it is impossible to explain in the *Vortex*, how Gravity decreases in an inverted *Ratio* of the Squares of the Distances; and consequently there will be nothing found in the *Vortex* to answer to

Attraction, whose Existence Sir *Isaac Newton* has so demonstratively established.

COROLLARY III.

Thus we have re-established in its full Light the Difficulty, which Monsieur *de Fontenelle* proposed to Monsieur *Villemot* in the Memoirs of the Academy for the Year 1705 *. This learned Academician pretends, that as in the *Vortex* the lower Points ought to move faster than the upper, in order to preserve *Kepler's* Astronomical Law; they ought also to have a greater centrifugal Force, and consequently compel them to descend, particularly in proportion to their Fluidity. The Objection made a great Noise, and the only Method found of getting rid of it, was by saying, that although each lower Point had more centrifugal Force than each upper; yet as the *Vortex* was in *Equilibrium*, and the Sums of the Force of each of the Two Layers were equal, there was no Reason why the lower *Stratum* should get the better of the upper; because this was as prevalent by the Number of its Points, as that was by the Force of each of its own.

But it is manifest, after what has been demonstrated above, that the second Layer, being assisted by the first, must have a greater Force than the third, and consequently compel it to descend, pursuant to the Principle then granted to Monsieur *Fontenelle*.

But if it be asked, How could the upper Layer descend, seeing Matter is impenetrable?

* He afterwards published a Book, intituled, *Nouveau Systeme, ou nouvelle Explication du Mouvement des Planetes, par M. Philippe Villemot, Pretre, Docteur en Theologie, &c. Lyon, 1707. in 12^o.*

I shall ask in my turn, How, in an intire *Plenum*, do heavy Bodies fall to the Centre? And I reason on the Principle granted to Monsieur *Fontenelle*.

But yet, because what is allowed by one *Cartesian* is not always allowed by all; let us suppose, that the upper Layer cannot descend; this, at least, will follow from my Demonstration, that, according to the Principles of all these Gentlemen, an upper Layer being pressed by all the under ones, it must hasten its Circulation, as long as it is slower than that of these under Layers; by reason that the Excess of their Velocities will act upon it, as if it had been at Rest.

C O R O L L A R Y I V.

Therefore the Layers of a *Vortex* will move all of a Piece, as do those of a solid Sphere; and *Kepler's* Law cannot possibly be preserved. We shall now give other Proofs upon other Principles.

T H E O R E M V.

The Motion of the Points of the Equator is absolutely independent of the Motion of the parallel Circles; and consequently, in order to determine the *Equilibrium* of the Points of the Equator, we must attend to nothing but its Motion.

D E M O N S T R A T I O N.

The Plane of the Equator is parallel to the Planes of the other parallel Circles, that turn round the same Axe with it: Its centrifugal Force is perpendicular to the Tangent to the Sphere, which answers to it: It has not then any lateral Tendency towards these
parallel

parallel Circles, and by a necessary Consequence its Motion is absolutely independent of theirs.

And indeed, if it be supposed, that the Motion of the other parallel Circles stops, there is still some Motion conceived in the Equator, just as in the Case of the cylindrical *Vortex*: It is likewise conceivable, that the Velocity may be greater at the Equator than in the parallel Circles, as the Experiment already cited shews us: And if no Regard be had to the lateral Frictions, as the *Cartesians* would have it, who suppose them none or insensible, and as indeed they are obliged to say, that the *Vortex*, by the lateral Friction of the Equator, may not become cylindrical; this Equator will always continue to circulate uniformly, without communicating any of its Velocity to the Points that laterally surround it. Therefore, &c. Q. E. D.

C O R O L L A R Y I.

Therefore for the *Equilibrium* of the Points of the Equator, it is necessary, at least, that an upper Circumference should have as much Tendency towards the Superficies of the *Vortex*, as another under concentric Circumference; because, if it had less, there would be no *Equilibrium*, even in the Principles of the *Cartesians*; and the under Circumference, pressing the upper, would either make it descend, or communicate to it a Force equal to its own. Wherefore, calling F the proper centrifugal Force of a Point of the upper Circumference, and f that of a Point of the under one; if S, s mark the different Sums of the Points contained in these Two Circumferences, we shall have $FS = fs$.

C o.

COROLLARY II.

Therefore the centrifugal Force does not diminish in the Plane of the Equator in the inverted *Ratio* of the Squares of the Distances from the Centre; for since $FS = fs$; $F.f :: s.S$. But the Points being supposed equal on both Sides, their Sums are as the Circumferences, and one has $s.S :: d.D$, which gives $F.f :: d.D$. instead of $:: dd.DD$.

COROLLARY III.

Therefore *Kepler's* Rules cannot be observed in the *Vortex*, or at least in the Plane of its Equator; for since $F.f :: d.D$; by putting in the Place of F, f , their Values, we shall have $\frac{VV}{D} \cdot \frac{uu}{d} :: d.D$, and therefore $V = u$ and $D^2.d^2 :: TT.tt$. whereas we ought to have $V.u :: \sqrt[2]{d}.\sqrt[2]{D}$ and $D^3.d^3 :: TT.tt$.

REMARK.

There is here a *Finesse* of the *Cartesians* to be observed. These Gentlemen consider only the *Equilibrium* of the spherical Layers of the *Vortex*, and from the Equality of their central Forces they deduce *Kepler's* Laws, as well as they can.

But it is manifest, that whatever becomes of the Equality of Force in different spherical Superficies of the *Vortex*, there must be an *Equilibrium* in the Plane of the Equator; because it is in this Plane that the Planets move; and if there had not actually been an *Equilibrium* between its Points, they would soon place themselves there, by reason that Fluids
always

always tend to the Side where they are less pressed; and it is by an actual *Equilibrium* alone that they are kept in their Places; which intirely overturns the Theory of these Gentlemen.

Let us however grant to the *Cartesians*, that the Sums of the Forces of the Two spherical Surfaces are equal; I cannot see, that they can thence infer, as they do, that the central Force diminishes in a reciprocal *Ratio* of the Square of the Distance from the Centre. Let us examine their Argument:

$FS = fs$, say they; therefore $F.f :: s.S$; but s, S mark the Sums of the Points contained in the Two Surfaces; therefore they are as these Surfaces, which, being as the Squares of their Distances, give, $F.f :: dd.DD$.

But it must be remarked, that the Surfaces of the *Vortex* are not Mathematical, they are Surfaces which have some Thickness: They cannot then be proportional to the Squares of their Distances from the Centre, except in the Case when their Thickness is equal. Now, according to the *Cartesians*, the Points or Globules, which compose the *Vortex*, increase in Bulk according as they recede from the Centre; and, besides, they are homogeneous, or of an equal specific Density, at least in their common System. And consequently it is certain, that the different natural or real *Strata* of the *Vortex* are not of an equal Thickness, and that the Matter contained therein is not proportionate to the Squares of the *Radii* of these Surfaces, but only to the Squares of these *Radii* multiplied by the Thickness of the *Strata*. Therefore, &c. *Q. E. D.*

COROLLARY IV.

Therefore, even allowing the *Cartesians*, what one has a Right (COROL. I. THEOR. IV.) to refuse them, they will never be able to explain *Kepler's* Rules in the *Vortex*; for it is only by the Proportion, which I have just now annulled, that they pretend to do it. See *M. de Moliere's Leçons de Physique*.

And if it be objected, that I have not, in the preceding Corollaries, had any regard to the Thickness of the Circumferences; I answer, that it was by way of pure Concession that I have not done it; and if any Person will be at the Pains of doing it, he will easily find, that *Kepler's* Rules will only be the more disturbed thereby.

CONCLUSION.

Therefore the *Vortex* is every way impossible, and insufficient in Natural Philosophy. Its mechanical Generation is impossible (PART I.); it has only an axifugal Force, and not a centrifugal and centripetal Force, as it should have (THEOR. I. and II.); and even if it had, it cannot (THEOR. III.) defend itself equally on all Sides. It is not sufficient for explaining Gravity, and its Properties; it destroys *Kepler's* Astronomical Laws (COROL. III. THEOR. IV. and V.). What more can be desired, in order to conclude with *Sir Isaac Newton*? “Itaque hypothesis Vorticum
“ (est impossibile &) cum phænomenis astronomicis
“ omnino pugnat, & non tam ad explicandos quam
“ ad perturbandos motus cœlestes conducit.” *Q.E.D.*

VII. *An Account by David Hartley, M. B. F. R. S. of Dr. Trew's Dissertation concerning the Differences of a Human Body before and after Birth, intituled, Diss. epistolica de differentiis quibusdam inter hominem natum & nascendum intervenientibus, deque vestigiis Divini Numinis inde colligendis. Jo Georgio Kramero inscripta. Cum Tab. Æn. Autore Christoph. Jacobo Trew, Noribergiae, 1736. 4^{to}.*

THERE are, according to Dr. *Trew*, Two remarkable Observations, which Animal Bodies suggest, *1st*, That the same general Ends are accomplished in different Animals by all the possible Varieties of Means. *2^{dly}*, That Animal Bodies are Machines, which produce in themselves all those Changes, that are necessary for their Preservation and Well-being. Thus the same general Ends of Chylification, Circulation, Secretion of Bile, &c. are accomplished in different Animals by Organs that differ considerably from each other; and in the same Animal the Body of the *Fætus* is very different in its Structure from that of the Adult, at the same time that this Difference is effected by the Body itself, each subsequent Variation, the natural and mechanical Consequence of that which immediately preceded, and the Whole conducted in the best possible manner for the Welfare and Happiness of the Animal.

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The Author's Design in this Dissertation is to consider those Differences of a Human Body before and after Birth, which affect the Circulation of the Blood. And for this Purpose he has given us 78 very curious and accurate Figures of the Parts relating thereto, such as the Heart, and Trunks of the great Blood-vessels, the Liver, the *Vena Portarum*, the Umbilical Chord, &c. subjoining to them a very minute and precise Explanation of each. Some of these Figures represent the Parts as they appeared immediately upon Dissection, others as inflated and dried, others again as injected with Wax; and lastly, others as having been first injected, and well dried, then cleared of the Injection, and laid open, in order to shew the several Cavities and Valves in their natural Dimensions and Positions. This last Method he prefers to all the rest, and observes, with relation to it, that the Injection must not be thrown in too hot, and that the internal Parts of the Preparation must be perfectly dry before we attempt to evacuate it; inasmuch as a Neglect of either of these Cautions would make the Valves, and their Membranes, shrivel up and contract themselves from their natural Sizes and Positions. The Manner of doing it is to suspend the Preparation in a proper Vessel placed in a gentle Heat, having first made an Aperture in the most depending Part, for the Injection to run out at.

From these Figures, with their Explanations, our Author draws the following Anatomical and Physiological Conclusions.

1st, That, contrary to *Casseri*'s Figure, the Umbilical Vein enters the Liver towards the Left Part of it.

2dly, That the Sulcus of the Liver, through which the Umbilical Vein passes, is not always the same. In some Subjects it surrounds the Vein along its whole Passage, in others only in Part of its Passage, and in others it is an imperfect Chancel, which merely receives the Vein.

3dly, There is but one Umbilical Vein, it empties itself into the Left Extremity of the *Sinus Venæ Portarum*, and sends no Branches to the Liver.

4thly, The Communication between the Umbilical Vein, and the *Sinus Venæ Portarum*, is so free, that the Blood has no Obstacle in passing either Way. Our Author asks therefore, What is the Cause of the Blood's Motion from the Umbilical Vein into the Liver, and whether the Pulsation of the Umbilical Arteries be one sufficient to produce this Effect?

5thly, The *Venæ Portarum* sends no Branches to the Liver, but opens into a particular *Sinus*, called *Sinus Venæ Portarum*; and this Opening is nearer to the Right Extremity of the *Sinus* than to the Left.

6thly, The Diameter of the *Venæ Portarum* is much less than that of the Umbilical Vein. The Diameter of the Left Part of the *Sinus Venæ Portarum* is generally larger than both these together, never much less than that of the Umbilical Vein; and the Diameter of the *Canalis Venosus* is least of all. The Blood therefore of the *Venæ Portarum* mixes with that of the Umbilical Vein in the *Sinus*. And since the Blood of the Umbilical Vein, which abounds with chylous Particles, does thus mix with that of the *Venæ Portarum* in the *Fœtus*, it may be asked, Whether in Adults the Branches of the *Venæ Portarum*, which arise from the Stomach and Intestines,

testines, do not suck up some chylous Parts from the Aliment? And whether both in the *Fœtus*, and in the Adult, Chyle be not a necessary Ingredient in the Composition of Bile? It is certain, that the Chyle passes into the *Vena Portarum* in Birds.

7thly, The *Canalis Venosus* empties itself into the *Cava Inferior*, where the Three Veins arising from the Liver empty themselves.

8thly, The *Valves* which are placed at the Two Extremities of the *Canalis Venosus*, facilitate the Ascent of the Blood in it, and also contribute to close it after Birth.

9thly, The *Valve* of the Coronary Vein is nothing else but its external Coat, something elongated within the Cavity of the Right *Auricle*; and its Use is to close the Orifice of this Vein when the *Auricle* is distended with Blood, just as the nervous Coat of the Bladder closes the Orifices of the Ureters when the Bladder is distended with Urine.

10thly, *Eustachius's Valve* is found both in the *Fœtus*, and in the Adult; and its Use seems to be, to direct the Blood's Motion variously, according to the various Circumstances of the Right *Auricle*, during its *Diastole* and *Systole*; and principally to hinder the Regress of the Blood into the *Cava Inferior*, when the *Auricle* is contracted.

11thly, The Use of the *Foramen Ovale*, and *Canalis Arteriosus*, seems to be, to intercept Part of the venal Blood, and transmit it to the Left *Auricle* and *Aorta*, that so the Whole be not forced upon the Lungs during their State of Inactivity in the *Fœtus*; of the Membrane, which is placed before the *Foramen Ovale*, to direct the Communication of the
Auricles

Auricles before Birth, and prevent it afterwards; and lastly, of the valvulous Productions at the Two Extremities of the *Canalis Arteriosus*, in like manner to direct the Blood in its Motion through this Canal before Birth, and to exclude it afterwards. Here our Author enters into a very minute Examination of Monsieur *Mery's* Hypothesis, but does not agree to it; affirming, that the Membrane of the *Foramen Ovale* is so placed as to permit the Blood to pass freely from the Right *Auricle* to the Left, during the *Diastrale* of the *Auricles*, but never from the Left *Auricle* to the Right.

12thly, The Use of the *Urachus* in the human *Fœtus* is not yet discovered. Our Author here supposes, according to the Determination of the best Anatomists, that the human *Fœtus* has no *Allantois*.

13thly, The Situation of the Stomach in the *Fœtus* is such, as makes up for the want of Action in the *Diaphragm*, as far as relates to Digestion. For as in the Adult, the Action of the *Diaphragm* facilitates the Descent of the Aliment, so in the *Fœtus* the *Cardia* is made to rise above the *Pylorus* more than in the Adult, from its Connexion with the *Diaphragm*, for the same Purpose.

14thly, The Smallness of the Stomach in new-born Children shews, that it ought not to be oppressed either with much Aliment at once, or with such as is gross.

15thly, The Descent of the *Testicles* into the *Scrotum* does not always happen at the same time.

16thly, The recurrent Nerve seems to be some way subservient to the *Canalis Arteriosus*. This our Author conjectures from its passing round the *Aorta* just

just where this receives the *Canalis Arteriosus*; but observes, that the Knowledge of the Use and Action of the Nervous System is much more imperfect than any other Branch of the Animal Oeconomy.

There is a short Dissertation (with Four Figures of the Tongue, its Vessels, Glands, Muscles, and Nerves annexed) by the same Author; whose principal Intent is to shew, that the Vessels called salival Ducts by Coschwitzius, are not salival Ducts, but Veins.

VIII. *Some curious Experiments and Observations on a Beetle, that lived Three Years without Food: Communicated to the ROYAL SOCIETY in a Letter from Mr. Henry Baker to Alexander Stuart, M. D. F. R. S.*

S I R,

WHEN I had the Honour of waiting on you lately, and was mentioning, in Conversation, the uncommon and surprizing Strength of Life bestowed by Providence on a certain *English* Insect, called by *Petiver*, *Scarabeus impermis tardipes*, the slow-legged Beetle. *Moff.* 139. *Fig. id. Angl.* 999. *Gaz.* Decad. 3^e, Tab. xxiv. 7. (whose Natural History, as to that Particular, has never, I believe, been touched on) you was pleased to think it so extraordinary, as to desire I would write down the Observations I had made, since the Accidents that led me into them may perhaps never again occur: And you seemed of Opinion, that their being known
may

may open a Way to more amazing Discoveries, and tend considerably towards enlarging our Notions of Animal Life in general.—In Obedience therefore to your Commands, I presume to lay before you a Series of plain Facts, without troubling you with my own Reflections, or endeavouring to set them off with any other Ornament than Truth.

In the Middle of the Month of *June* 1737. I happened to be at a Relation's House at *Tottenham* in the County of *Middlesex*; and whilst I was there, a large Cistern of Lead, that was placed in the Coach-house-yard, to receive by Pipes the Rain-water from some Out-buildings, fell down, through the Failure of a wooden Frame whereon it stood. My Curiosity led me to examine into this Cistern; and at the Bottom of it, I observed several black *Beetles*, plunging in a muddy slimy Sediment, which the Water had left. Taking out Two or Three of them, I found them of a middling Size, somewhat above an Inch in Length, having Six pretty long Legs, with Two little Hooks at the Extremity of each, in the Manner of the common *Beetles*: They were all over of a rusty black Colour, with *Antennæ* long and jointed; a Body covered with one strong Shell, forming an Appearance of Case-wings, but undivided, and without any filmy Wings underneath, and a Tail turning up a little: In short, they resemble very much a Sort of *Beetle* that is sometimes seen in Houses, but were of a stronger and much more firm Contexture.

As I have preserved most of our *English* Insects, (after a Manner I shall not here take up your Time in describing) I chose one of the largest of these *Beetles*, and threw it into a Cup full of common *Lamp-spirits*,
 . (that

(that being the Way of killing and preparing them for my Purpose) and in a few Minutes it appeared to be quite dead : Whereupon I shut it up in a round Pill-box of about an Inch and half Diameter, and carried it in my Pocket next Day to *London*, where I tossed it into a Drawer, and thought no more of it for above Two Months after ; when, opening the Box, I found it, to my great Surprize, alive and vigorous ; though it had nothing to eat for all that Time, nor received any more Air than what could be met with in so small a Box, whose Cover shut very close. Having, however, no Intention of keeping it alive, I again plunged it into *Spirit of Wine*, and let it lie considerably longer than the First time, till supposing it dead beyond any Possibility of Recovery, I put it into the said Box again, and locked it in my Drawer, without looking any more at it for a Month at least, when I found it again alive.——And now I began to imagine there must be somewhat extraordinary in this Creature, since it could survive the Force of *Spirit of Wine*, which soon kills most other Insects, and live for Three Months, without taking in any Sustenance.

A few Days before this, a Friend had sent me Three or Four *Cock-Roches*, or as *Merian* calls them, *Kakkerlacæ*, brought alive from the *West-Indies* : These I had placed under a large Glass of Six or Seven Inches Diameter, made on purpose to observe the Transformation of *Caterpillers* : And now I put my *Beetle* amongst them, that he might enjoy a greater Share of Liberty than he had done for Three Months before. I fed them with green *Ginger* moistened in Water, and they eat it greedily ; but I

could not find, nor do I believe, that the *Beetle* ever tasted it during the whole Five Weeks they lived under the Glafs together. I often took notice, that the *Cock-Roches* would avoid the *Beetle*, and seem frightened at his Approach; but never observed any Tokens of his Liking or Diflike of them, for he ufually stalked along, without regarding whether they came in his Way or not. Perceiving the *Cock-Roches* begin to decline in Vigour, I was afraid they would lofe much of their Beauty, if I permitted them to die of Sicknefs, and would become unfit to be preferved as I propofed: Wherefore I put them into *Spirit of Wine*, and the *Beetle* their Companion with them. They appeared dead in a few Minutes, and I believe were really fo: The *Beetle* feemed likewise in the fame Condition: Whereupon, after they had lain in *Spirits* about an Hour, I took them out, and whelmed the Glafs over them, till I fhould have Leifure to difpofe of them as I intended. This was about Ten o’Clock in the Morning, and I faw them no more till Evening, but found the *Beetle* then creeping about as ftrong and vigorous as ever: And therefore I refolved to put him to a Trial I imagined he could not poffible furvive, which was to let him remain a whole Night in *Spirits*; but here too I found myfelf miftaken, for after he had been taken out a Day, he appeared as lively as if nothing had happened to him.

Since that time I have put him no more in *Spirits*, but have kept him under the Glafs afore-mentioned, where he is alive at prefent: Though during the Two Years and half he has been in my Poffeffion, I have never been able to difcover, that he has drank or eaten any thing.

I must not conceal, however, that, by way of Experiment, I have put under his Glass, at different times, Water, Bread, Fruits, &c. but I never found them in the least diminished or touched by him. These Trials too were always made at many Months asunder, and I am pretty certain, there has been at least a Year together, during some Part of the aforesaid Time, wherein nothing has been offered him either to eat or drink.

The Question will then be, How this Creature has been wonderfully kept alive for Two Years and an half, without taking any visible Food? — And, Sir, your Supposition, that it finds its Nourishment in the Air, carries with it the highest Probability: Since, as you was pleased to observe, there are Particles in the Air which evidently supply a Growth to Plants of some particular Kinds, such as the *Sempervive*, *Orpine*, *House-leek*, &c. And the same or some other Particles therein contained may possibly be likewise able to afford a Nourishment to Animals of some certain Kinds. — There is a farther Reason also to believe, that something like this must be; for, in the amazing Plan of Nature, the *Animal*, *Vegetable*, and *Mineral* Kingdoms are not separated each from other by wide Distances, or broken off by sudden Starts, but differ from each other (near their Boundaries) by such minute and insensible Degrees, that it is impossible to find out certainly where the one begins, or where the other ends. — As the Air, therefore, yields Nourishment to some Kinds of Plants, it may probably do the same to some Kinds of Animals; for otherwise a Link would seem wanting in the mighty Chain of Beings. — And that *Chameleons*, *Lizards*, *Snakes*,

Sc. can live for Months together without any visible Sustenance, is a Fact generally allowed to be true; the Cause of it too has been attributed to an exceeding slow Digestion, Circulation, and Distribution of Nourishment, in those Creatures; but as their Agility seems to imply a brisk Motion of their *animal Spirits*, I am inclined to think the Circulation of their other Fluids cannot be so sluggish as commonly is supposed: And, perhaps, it may not be unreasonable to believe, that their being able to live so long without visible Food, is rather owing to some other Nourishment they receive from the Air, which supplies the want of more substantial Diet.

I have met with no Instance I could give Credit to, of any Creature's living without Food for so long a time as the *Beetle* I have been mentioning; and yet I doubt not, (though it may have been kept alive by Air only) but that, in its natural State, it eats more solid Food; after somewhat the same manner as the Plants before-named thrive best when set in a little Earth, notwithstanding they may flourish a long while, and send forth Branches and Flowers, when they are suspended in the Air, and receive no Nourishment but from the Humidity or some other Qualities thereof.

We have not, indeed, as yet, many Instances of this Sort in Animals; nor is it probable any of the larger Kinds can live long without Supplies of Food: But there may be several Insects capable of subsisting on minute Particles carried about every-where with the Air, though, for want of sufficient Experiments, we are not acquainted with them.

Its reviving so often after being seemingly killed by *Spirit of Wine*, shews a Strength of Life I never found in any other Insect: Some Kinds, indeed, will come to Life again, if taken out as soon as they appear dead; and the *Ear-wig*, in particular, after continuing so some Minutes: But half an Hour in *Spirits* puts a final End to the Life of all the *Insects* I ever tried, except this *Beetle*.

It walks not much about under the Glass that covers it, but is usually found with its Nose thrust close down to the Bottom thereof, perhaps to suck in the Air. On removing the Glass, it appears robust and vigorous, and would willingly run away. A strong aromatic kind of Smell issues from it, agreeable enough when there is not too much of it; and the same Scent hangs about the Fingers a long while after touching it.—Since the Weather has been so excessive cold, it is grown somewhat torpid; but till now has always appeared as lively in cold as in hot Weather, and I have observed its Smell to be stronger in Winter than in Summer. In the exhausted Receiver, where I have kept it sometimes for half an Hour, it seems perfectly unconcerned, walking about *in Vacuo* as briskly as in the open Air; but, upon Admission of the Air, it shrinks its Legs together, and appears in a Surprise for near a Minute.

We know the *Egyptians* had a high Veneration for the *Beetle*, by their many Images thereof, which are still preserved in the Cabinets of the Curious, and Historians tell us it was one of their Deities: But, as the *Egyptians* were a wise and learned People, we cannot imagine they would shew so much Regard to a Creature of such a mean Appearance, without some extraordinary Reason for so doing:

And

And is it not possible they might have discovered its being able to subsist a very long time without any visible Sustenance, and therefore have made it a Symbol of the Deity? In the same Manner as it is probable the *Onion* was held sacred by them, for representing the *Orbits* of the *Planets*.—But these Conjectures may seem impertinent to one so used to curious Disquisitions, and therefore I shall not dare intrude on your Time any longer, than to profess myself, with the greatest Respect,

S I R,

Your most humble Servant,

Strand, Jan. 2. 1739-40.

H. Baker.

P. S. This *Beetle* (after being kept half a Year longer) was permitted to get away, by the Carelessness of a Servant, who took down the Glass to wipe it.

See the Figure of this Insect, in TAB. II. Fig. I.

IX. *The Discovery of a perfect Plant in Semine; by Mr. Henry Baker.*

SINCE the antient Supposition of *equivocal Generation* has been rejected, for a more reasonable Belief, that every Thing proceeds from Parents of its own Kind, Numbers of curious People have busied themselves in Search of Experiments, whereby to demonstrate the Truth of the latter, and consequently the Falsity of the former Opinion. For this Purpose the *Animal* and *Vegetable* Worlds have been examined, and such Analogy found between them, as proves convincingly, that their *Generation* and *Increase* are brought

brought about in a Manner pretty much alike. The animal and vegetable *Semina* are found to be alike the *Rudiments* of their future Offspring; and both alike require only a proper Repository to preserve them from Injuries, and proper Juices to advance their Growth, and bring them to Perfection.

Glasses (which the Moderns have so much improved) are the Means whereby these Secrets in Nature are discovered to us. The Eye, assisted by a good Microscope, can distinguish plainly, in the *Semen masculinum* of Animals, Myriads of *Animalcules* alive and vigorous, though so exceedingly minute, that it is computed three thousand Millions of them are not equal to a Grain of Sand, whose Diameter is but the one hundredth Part of an Inch: And the same Instrument will inform us beyond all Doubt, that the *Farinae* of Vegetables are nothing else but a Congeries of minute *Granula*, whose Shapes are constant and uniform as the Plants they are taken from. And as the Seeds of Plants are found by repeated Experiments to be unprolific, if the *Farina* be not permitted to shed, it has been supposed, that all its *Granula* contain *Seminal Plants* of their own Kind.

The *Growth* of Animals and Vegetables seems to be nothing else but a gradual Unfolding and Expansion of their Vessels by a slow and progressive Insinuation of Fluids adapted to their Diameters, until, being stretched to the utmost Bounds allotted them by Providence at their Formation, they reach their State of Perfection, or, in other Words, arrive at their full Growth.—If this be granted, the Consequence must be, that all the Members of a perfect Animal *exist* really in every *Animalcule* of the *Semen animale*

animale masculinum, and all the Parts of a perfect Plant in every *little Grain* of the *Farina Plantarum*, however minute either of them may be.

According to this *Theory*, it is supposed by some, that, in *Animals*, the *Semen* of the Male being received into the *Matrix* of the Female, some of the *Animalcules* it contains in such Abundance, find an Entrance into the *Ovaria*, and lodge themselves in some of the *Ova* placed there by Providence as a proper *Nidus* for them. An *Ovum*, becoming thus inhabited by an *Animalcule*, gets loosened in due time from its *Ovarium*, and passes into the *Matrix* through one of the *Fallopian Tubes*. The Veins and Arteries that fastened it to the *Ovary*, and were broken when it dropped from thence, unite with the Vessels it finds here, and compose the *Placenta*: The Coats of the *Ovum*, being swelled and dilated by the Juices of the *Matrix*, form the *Chorion* and the *Amnion*, Integuments needful to the Preservation of the *little Animal*, which, receiving continually a kindly Nourishment from the same Juices, gradually stretches and enlarges its Dimensions, becoming then quickly visible with all the Parts peculiar to its Species, and is called a *Fœtus*.

In *Plants*, say they, (which are incapable of removing from Place to Place, as *Animals* can) it was requisite a *Repository* for their *Farina* should be near at hand to prevent its being lost; and accordingly we find, that almost every Flower, producing a *Farina*, has likewise in itself a proper *Ovary* for its Reception; where the *Ova* thereby impregnated are expanded by the Juices of the *Parent Plant* to a certain Form and Bulk, and then, becoming what we call

call *ripe Seeds*, they fall to the *Earth*, which is a natural *Matrix* for them.

According to the above Supposition, a *ripe Seed*, falling to the *Earth*, is in the Condition of the *Ovum* of an Animal getting loose from its *Ovary*, and dropping into the *Uterus*: And, to go on with the Analogy, the Juices of the *Earth* swell and extend the Vessels of the *Seed*, as the Juices of the *Uterus* do those of the *Ovum*, till the *Seminal Leaves* unfold, and perform the Office of a *Placenta* to the Infant included Plant; which, imbibing suitable and sufficient Moisture, gradually extends its Parts, fixes its own Root, shoots above the Ground, and may be said to be born.

Others disapprove of this *Hypothesis*, and insist that no *Animalcule* can possibly enter the *Ovum animale*, nor any Particle of the *Farina* get into the *Embryo* of a Seed: But, say they, in Animals, either the finest Part of the *Semen* is taken in by the Vessels of the *Vagina* and *Uterus*, circulated with the Fluids, and carried into the *Ovaria*, and even into the *Ova*, by the Vessels that run thither; or else, Fecundation is occasioned by a *subtile Spirit* in the *Semen masculinum*, which passes the *Uterus*, enters the *Ovaria*, pervades the Female *Ova*, actuates and enlivens the *Seminal Matter* in them contained, and produces all the various Symptoms of Conception:—In Plants too, say they, the same is effected by penetrating *Effluvia* from the *male Semen* or *Farina*.

This Account of animal and vegetable Generation is intended to introduce a Discovery, which may possibly some way lead to a greater Certainty about it.

Amongst numberless Inquirers, whom the Opinion, that every Seed includes a real Plant, has set at work to open all Kinds of Seeds, and try by Glasses to find evident Proofs thereof, I have not been the least industrious: But after repeated *Experiments*, in every Manner I could think of, and with the utmost Nicety in my Power, I began to despair of ever attaining an ocular Demonstration of it. If by moistening the Seed it began to vegetate, I could indeed discern the *seminal Leaves*, and the *Germen* or *Bud*, whence the future Plant should arise; but was able to go no further, unless I waited till the Moisture gradually extending its Vessels made the little *Root* shoot down, the *Stalk* rise up, and the *minute Leaves* expand, and bring themselves to View. This, however, was not the Thing I sought for: But, some Days ago, mere Accident, when I thought nothing about it, favoured me with a Discovery I had so often searched after to no purpose.

Endeavouring with a fine Lancet to dissect a Seed of the *Gramen tremulum*, (a Seed whereof is placed in the Hole, marked Fig. 1. of the Ivory Slider herewith presented, and as it appears in TAB. II. Fig. 2. prefixed to this *Transaction*) with Intention to examine the several Parts of it with a Microscope, imagining I might find somewhat curious in the Contexture of its Husk, the Edges of which I observed to be transparent, I opened it the long Way exactly in the Middle, and took notice of something exceeding small between the Two Sides, which I had separated. I stuck the Point of the Lancet into it, with no other Design than to take it up, and place it in the Microscope to see what it might be; which I had no sooner done, than,

than, to my great Surprize and Joy, I found the Lancet had fortunately opened a membranous Case, that included a *perfect Plant*, arising from a double Root in the Basis of its said Case, with Two Stems of an equal Height, each whereof had many Leaves upon it, like the Grass from whence it was produced. This was a Sight I little expected to meet with; and being aware how much Imagination has frequently had to do with microscopical Observations, I distrusted my own Eyes, and examined it every way I could contrive, to prevent being deceived; but in all Positions I found it a Reality. Wherefore having secured it between Two Pieces of *Isinglass*, together with the Cases that inclosed it, (as in the Hole of the same Slider, Fig. 2. (see TAB. II. Fig. 3.) I afterwards cut open a great many Seeds of the same sort, in hopes I might be able to separate one of these *minute Plants* intirely from its *Theca*; which at last I successfully effected, and placed as in the Hole (see TAB. II. Fig. 3, 4).

Having never met with any Experiment, that so plainly proved the Existence of a real and perfect Plant in *Semine*, I imagined an Account thereof might be acceptable to this most learned SOCIETY, which encourages every Endeavour for the Advancement of true Knowledge: And I beg Leave, with all Submission, to recommend to your Consideration, how far this Discovery may conduce towards ascertaining the Manner of Generation.

A Dozen Lines, in a little Poem called *The Universe*, are so adapted to the present Subject, that, if a Quotation from myself may be excused, I shall conclude with them.

*Each Seed includes a Plant: that Plant, again,
Has other Seeds, which other Plants contain:
Those other Plants have All their Seeds, and Those
More Plants again, successively, inclose.*

*Thus, ev'ry single Berry that we find,
Has, really, in itself whole Forests of its Kind,
Empire and Wealth one Acorn may dispense,
By Fleets to sail a thousand Ages hence.
Each Myrtle Seed includes a thousand Groves,
Where future Bards may warble forth their Loves.
Thus Adam's Loins contain'd his large Posterity,
All People that have been, and All that e'er shall be.*

Henry Baker.

An Explanation of the Figures. See TAB. II.

Figure 1.

The Beetle, mentioned in the preceding Paper.

Figure 2.

*A Seed of the Gramen tremulum intire, of the
natural Size.*

Figure 2 *.

The same magnified.

Figure 3.

A Seed of the Gramen tremulum dissected, viz.

A. *One Lobe or Side of the Seed.*

B. *A membranous Case containing a minute Plant,
which arises with Two Stems bearing many
Leaves*

Leaves from its Radicle in the Basis of the said Case: This Case lies between the Two Lobes, and, before it is opened, seems to be the Germen of the Seed.

C. *A Piece of the Case cut off in opening.*

Figure 4.

A. *A Lobe of the Seed.*

B. *The minute Plant extracted from its Case, that its Root and Branches may be seen to better Advantage.*

C. *The Case whence the minute Plant was taken.*

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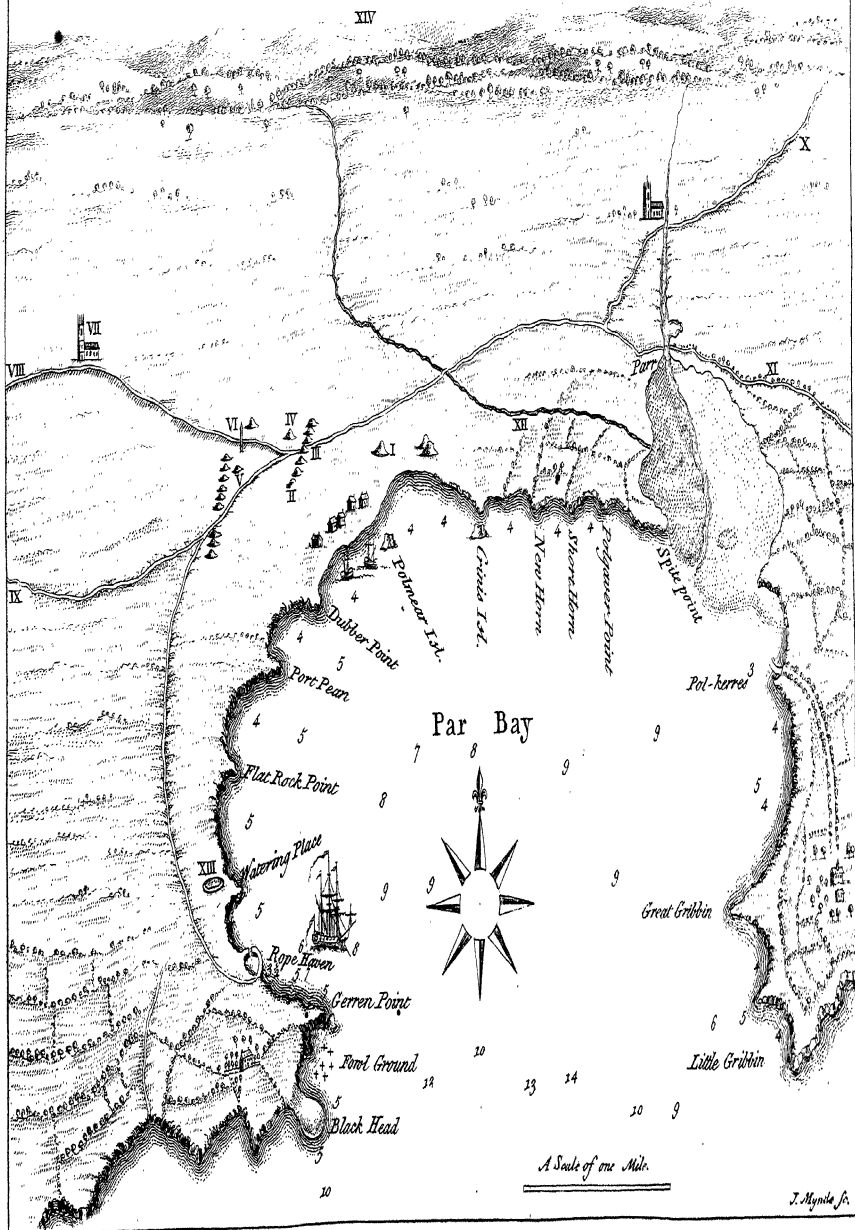
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TAB II.

Barrow N^o III

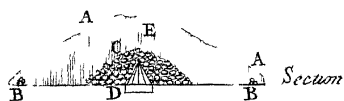
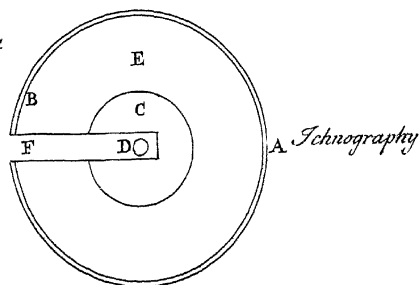


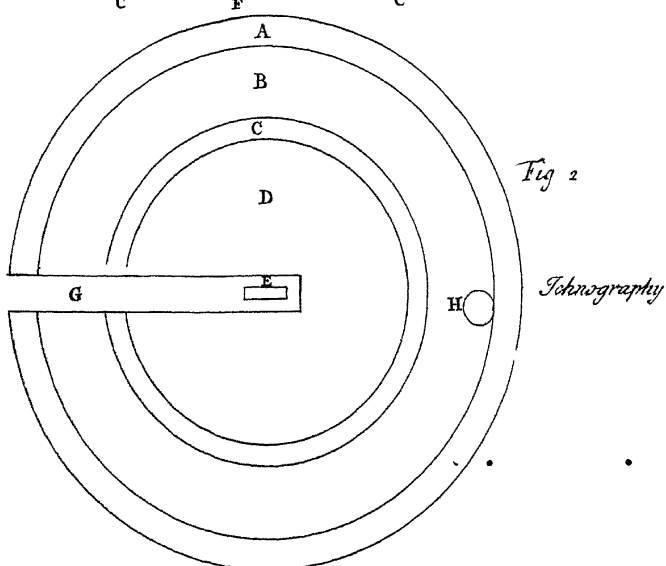
Fig 1



Barrow N^o IV.



Fig 2

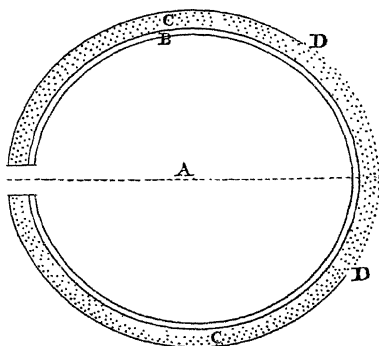


A Scale of feet for Barrow N^o III & IV.



Plan of Castle Gotha

Fig. 4.

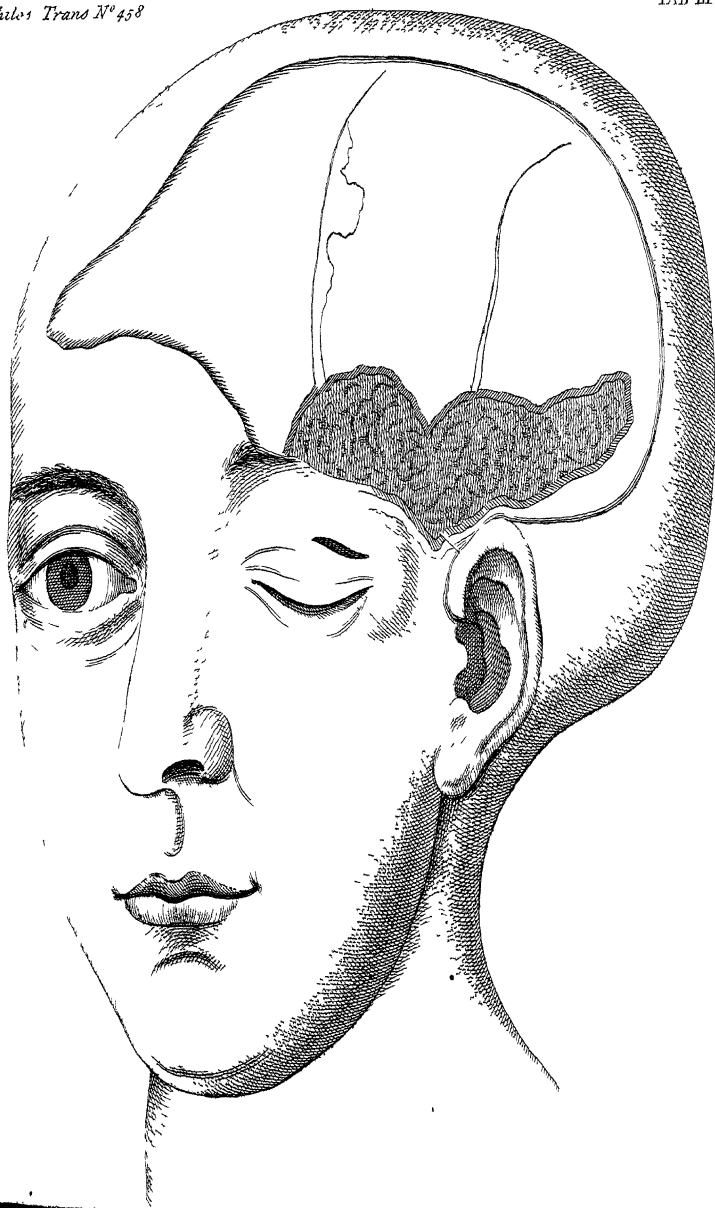


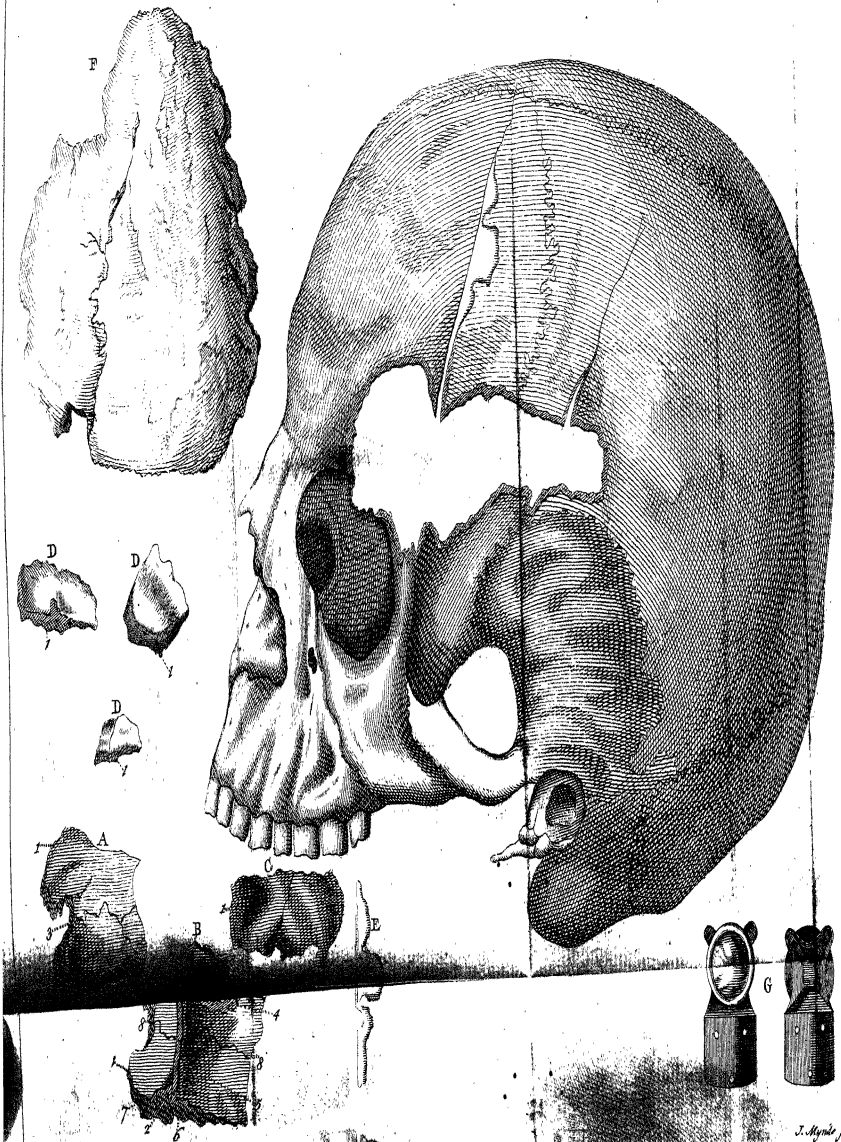
The Urn

Fig. 3.



J. Myrdsen sc.





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and *December, 1740.*

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- X. *An Inquiry into the Causes of a dry and wet Summer. By an anonymous Hand.* 519.
- XI. *Notabilia quædam in Itinere Alpino-Tyrolensi observata per Balthasarem Ehrhartum, M. D. Memingensem, in Epistola ad C. Mortimerum, R. S. Secr. missa.* 547.
- I. An

I. *An Account of the Analogy betwixt English Weights and Measures of Capacity, by the Rev^d Mr. William Barlow of Plymouth.*

THE Analogy betwixt antient *English* Weights and Measures seems for many Ages to have been intirely forgotten and unknown.

Our Forefathers supposed a cubic Foot of Water (assumed as a general Standard for Liquids) to weigh 62 Pound $\frac{1}{2}$; the Exactness of which Supposition is confirmed by modern Observation: For in *Philosophical Transactions*, N^o 169. we find the Weight of a Foot of Pump-water to be 62 Pound 8 Ounces. From a cubic Foot of Water multiplied by 32, is raised a Ton Weight, or 2000 Pound, luckily falling into large round Numbers, and for that Reason made Choice of.

Agreeably hereto were liquid Measures accommodated, *viz.* 8 cubic Foot of Water made a Hogshead, and 4 Hogsheads a Ton in Capacity and Denomination as well as Weight.

Dry Measures were raised on the same Model. A Bushel of Wheat (assumed as a general Standard for all sorts of Grain) was supposed to weigh 62 Pound $\frac{1}{2}$, equal to a Foot of Water; 8 of these Bushels a Quarter, and 4 Quarters a Ton Weight.

Coals were sold by the Chaldron, which was supposed to weigh a Ton or 2000 Pound. See *Chambers's Dictionary*.

Therefore, though the Measures containing a liquid Ton, 4 Quarters of Wheat, a Chaldron of Coals,

N n n

&c.

&c. be all of different Capacities; yet the respective Contents are every one of the same Weight: A Ton in Weight is the common Standard of all.

In After-times, through Ignorance of this Analogy, a Variety of Weights and Measures were introduced, incommensurate, and not reducible to any common Standard, or analogous Relation: Whereas, had the original Analogy been kept up, it would have prevented that Disorder and Confusion so justly complained of at present concerning the Subject of Weights and Measures.

From the foregoing Scheme it is reasonable to suppose, that Corn, and several other Commodities, both dry and liquid, were first sold by Weight; and that Measures, for Convenience, were afterwards introduced, bearing some Analogy to the Weights before made use of.

From the modern Experiment before-mentioned, (a cubic Foot of Water weighing 62 Pound 8 Ounces) it appears, that the Measure of a Foot, and the Weight of a Pound, are the same now as were in Use many Ages before the Conquest.

The foregoing Scheme assigns a Reason, why the word *Ton* is applied both to Weight and liquid Measure; *viz.* because the same Quantity of Liquor is a Ton both in Weight and Measure. Probably 4 Quarters of Grain had formerly the same Appellation, till the Significancy of it was lost in the Use of the *Avoirdupois* Ton.

The Word *Quarter*, as applied to Grain, is also hereby explained. Most Writers have supposed it the 4th Part of some Measure, but what that Measure was could never satisfactorily be made out. The
learned

learned *Fleetwood* guessed nearest the Truth, supposing it the 4th Part—not of any Measure, but—of some Load or Weight [*Chron. Pretios.* p. 72.]. I wonder he stopped here, and did not observe what that Load of Weight was, *viz.* a Tun or 2000 Pound: But the *Avoirdupois* Ton, in Use at present for all gross Weights, threw such a Mist upon the Subject as could not easily be seen through.

From the original and natural Signification of the word *Hundred*, it plainly appears, that *Twenty hundred*, or a *Ton*, must be exactly Two thousand Weight.

II. *An Account of a Tract intituled, Jo. Frederici Weidleri Commentatio de Parheliis Mense Januario Anni 1736. prope Petroburgum Angliæ & Vitembergæ Saxonum visis. Accedit de rubore cœli igneo Mense Decembri Anni 1737. observato Corollarium. Vitembergæ, 1738. 4º. Drawn up by Tho. Stack, M. D. F. R. S.*

THIS Tract is divided into 17 Sections. In the 1st and 2^d the Author describes his own Observation of Two Mock-Suns at *Wittemberg*, on *Jan. 11. 1735-6, N.S.* In the 3^d he gives a Meteorological Diary from *Jan. 1. to 18.* and in the 4th the Revd Mr. *Neve's* Observation on ^{*Dec. 31.*}_{*Jan. 11.*} of Two *Parhelia* near *Peterborough*. But these Descriptions have been already communicated to the ROYAL SO-

CIETY*. In the 5th he compares the Two Observations. In the 6th and 7th, he mentions several *Parheli* taken notice of by the Antients and Moderns; and in the 8th enumerates the different Observables of this *Phenomenon*, for the better investigating its Causes.

The 9th gives the Opinions of several of the Antients concerning the Prefages taken from Mock-Suns.

From the 10th to the 13th inclusive, he relates divers Manners of accounting for them, by the chief of the Antients and Moderns.

In the 14th, preparatory to his own Opinion, he lays down the Doctrine of the Rise of Vapours in small globular Bubbles of Air, with a watery Coat to each.

In the 15th, he refutes, by several Reasons and Experiments, *Huygens's* Manner of accounting for *Halo*es, which is, by a vast Number of very small Vapours, each with a snowy *Nucleus*, coated round with a transparent Covering: And says, that when the Sun depicts its Image in the Atmosphere, and by the Force of its Rays puts the Vapours in Motion, and drives them towards the Surface, till they are collected in such a Quantity, and at such a Distance from the Sun on each Side, that its Rays are twice refracted, and twice reflected, by the time they reach the Eye; they exhibit the Appearance of a *Halo*, adorned with the Colours of the Rainbow: Which may happen in globular pellucid Vapours without snowy *Nuclei*, as appears by the Experiment of hollow glass Spheres filled with Water. Therefore, whenever those spherical Vapours are situated, as before,

* *Philosophical Transactions*, N^o 445.

fore, the Refractions and Reflexions will happen every-where alike, and the Figure of a circular Crown, with the usual Order of Colours, will be the Consequence.

As to the *Halo*, that attends *Parhelia*, being 44 or 45 Degrees in Diameter, he adopts *Gassendi's* Opinion as probable, who applies to it the Geometrical Theorem: *De Angulo ad Centrum, duplo Anguli ad Peripheriam*. For when a *Halo* surrounds the Sun, the Sun is in the Centre, and the Eye out of it, as it were on the Surface of the *Phænomenon*; whereas, when the Rainbow appears, the Eye is placed in a Line drawn from the Sun to the Centre of the Rainbow: And thus the Eye serves for a Centre, from which the Diameter of the *Iris* is beheld, the Sun being placed on the Circumference. Yet he says, it still remains to be accounted for, Why, when Two *Haloes* appear at once, the Greater is double the Diameter of the Less, *i. e.* about 90 Degrees?

16th, But as *Haloes* often appear about the Sun and Moon, without *Parhelia* or *Paraselinæ*, there must be a peculiar Disposition of Vapours requisite for forming *Parheliæ*.

Parheliæ, he says, are situate either in the Intersection of a vertical *Halo*, and the horizontal *Annulus*, which passes through the Sun; or in the Section of some horizontal Bands and the *Corona*: And the angular Figure of *Parhelia* leaves us no room to doubt, that it is produced by Planes of the *Annulus* or Bands running into the *Corona*. Now *Newton's* Theory of Colours, and the Experiments it is built upon, shew, that Whiteness, which is a heterogeneous Light, is restored by blending or collecting

collecting the coloured Lights: And this will likewise happen, when the white heterogeneous Light of the bright Ring or Band does penetrate and confound the Rays of the *Halo*, now somewhat weakened. It is plain, that in order to a genuine Explanation of Mock-Suns, it is chiefly requisite to have a clear Notion of the Origin of the horizontal Ring, or Bands. And from *Huygens's* Experiment with a cylindric Glass full of Water exposed to the Sun, which produces a white horizontal Ring by Reflexion alone, without an opaque *Nucleus*; he asserts that the horizontal Bands, that intersect the solar *Coronæ*, are formed, when cylindric frozen Vapours are suspended about the Sun, chiefly where the *Halo* is depicted, in a Situation perpendicular to the Horizon; which being rectilinear, each of them exhibits by Reflexion a lucid Line equal to the Sun's Diameter; and several of these optic Lines joining, compose the Plane of the Ring or Band.

His last Section is spent in explaining the Appearance of Part of an inverted *Iris*, which accompanied his Mock-Suns: In order to which, he thus accounts for a (common or) primary Rainbow.

A primary *Iris* is formed, when the Sun's Rays falling on Drops of Rain, after suffering Two Refractions, and One Reflexion, tend to the Eye in such a Direction, that the Axis of the *Iris*, coming directly from its Centre, and passing by the Eye to the Sun, makes with these Rays returning from the Drops, an Angle of 40° Degrees below, and of 42° Degrees above; whereby the Width of the *Iris* is $2^{\circ} 15'$, and its Diameter $42^{\circ} 17'$.

But as this inverted *Iris* was but One Degree broad, and the Diameter of the Arch probably but half that

of the primary *Iris* ; he is of Opinion, that the Sun's Rays, refracted and reflected as above, entered the Eye at half the aforelaid Angle, by the Eye's being placed beyond the Point, where the Rays met with the Axis. For thus the Order of the Colours is preserved, and this *Iris* is but half the Size of the common one.

As an Appendix to this Tract, Professor *Weidler* adds the following Account of the remarkable red Lights on the $\frac{16}{5}$ *December* 1737. seen not only by him at *Wittemberg*, but here at *London*, and in most Parts of *Europe*.

December 9. 1737. the Barometer was remarkably low; viz. 28 Inches 8 Lines *Engish* Measure. It rained all that Day very plentifully; and from thence to the End of the Month the Sky was much loaded with thick Vapours. But on the 16th, the little Wind there was being at North-west, and the Barometer at 30 Inches 2 Lines $\frac{3}{4}$ *London* Measure, soon after Sun-set, (the Moon in its last Quarter) the Sky began to appear very red; and, from Seven to Nine, gave a Light as strong as that of the Full Moon behind a thin Cloud. The whole Sky was of that Colour, which is occasioned by a Fire seen at a Distance in the Night. Such an uncommon Sight put the Inhabitants of this Town in great Terror. The greatest Brightness here was about 8 h. 45'; from which Time it gradually decreased; and at a Quarter after Nine it seemed almost dissipated. But it returned now-and-then, and continued, by Intervals, all Night. Now though the whole Face of the Heavens was remarkably red, yet the greatest Brightness

was

was in the North, and a little to the West. There were neither Pyramids, nor luminous Streamings, so common in *Auroræ Boreales*; nor even the least Appearance of the horizontal black Cloud at North. The following Day was equally dark with the preceding, yet without the least Remains of the Redness. Such was the Face of the Heavens at *Wittemberg*, and in the Neighbourhood. And, soon after, the public News gave an Account of the like *Phænomenon* being seen at *Vienna, Venice, Mantua, Florence, Rome*, and some other Places. At *Vienna* the greatest Brightness was observed at 9 h. 15'. The most enlightened Parts were the North-west and South-south-east; and there were some Returns of the Brightness on the 17th and 18th. But in *Italy*, at *Mantua, Florence, and Rome*, the Redness was accompanied with lucid Columns and Pyramids. And from *Rome*, in particular, they write, that this *Aurora Borealis* exceeded in Brightness all those that had been hitherto observed. From these Observations it is no difficult Matter to deduce the Causes of these red Lights.

That this *Aurora Borealis*, on the 16th, was a very considerable one, appears both by the great Expansion of the luminous Matter from its Rise in the North towards the South, and by the Return of the Brightness seen at *Vienna* on the subsequent Days. At *Mantua* the Northern Light reached the *Zenith*, and it is more than probable it did so in our more Northern Horizon: Wherefore, as the Matter was collected at the *Zenith*, the Light was reflected thence to all Parts of the Sky. But as the lower Region of our Atmosphere was at the same time overspread
with

with Vapours of a certain uniform Density, and intirely proper for separating an homogeneous Light; those Rays of the heterogeneous Light, which are the least refrangible, or which produce the red Colour, were accordingly separated by Reflexion and Refraction in great Quantities, and coloured the whole Sky with a fiery Redness. And where the Light was brightest, *viz.* between the North and West, which is generally the Focus of *Auroræ Boreales*, there likewise the Redness was strongest.

III. *An Attempt to examine the Barrows in Cornwall, by Stephen Williams, M. D. F. R. S.*

IT may not be improper to observe, that these *Barrows*, or conical Hillocks, are generally situated on Places of Eminence, on or near the Summit of Downs, and so capable of being seen at a great Distance; and likewise very often near the most public or greatest Roads, though sometimes in inclosed or fenced Lands, but not often: They lie sometimes Two, Three, even Seven, in a strait Line, now-and-then only One or Two by themselves: Sometimes also the single ones seem to regard, in respect of their Position, a greater Number, as is observable in TAB. I. N^o IV. where the Urn was found, and N^o V. on the same Down.

The Height and Dimensions of the *Barrows* in *Cornwall*, are various, from Four to Thirty Feet high, and from Fifteen to One hundred and Thirty broad;

but they always bear a regular Proportion in their Form. Some have a *Fessa* or Ditch round their Circumferences, others none; some a small Circle of Stones at the Top, others none; some a Circle of Stones round the extreme Verge of their Basis.

The *Barrows*, which are the Subject of our present Inquiry, lie on the Summit of *St. Austle Downs*, about a Mile from the Town, and half a Mile from the Sea; where a fine Bay is formed by Nature, well defended from most Winds, with good Anchorage, and deep Water. Mr. *Mitchel*, Lieutenant in the Navy, has lately taken a curious Survey of it, by Order of the Admiralty, and for the Benefit of the *English Fleet*. See TAB. I.

B A R R O W, N^o I.

We opened *Barrow*, N^o I. a small one, with no Ditch round it, but a small Circle of Stones on the Top, of the Height of Four Feet, of the Breadth, at the Basis, of Fifteen: When we had taken off the Surface, the Body of the *Barrow* seemed to be composed of foreign or adventitious Earth, which being cut through near the Centre, we found a circular Pit of a Foot deep, and of the same Diameter, dug out of the natural Soil of the Country, and Two flat Stones in it. By adventitious or foreign Earth, is meant such as does not rise on the Place, but is fetched from some Distance; so the Earth of this and the other *Barrows*, of a yellow Colour, is known to be the natural Soil of a Hill a Mile distant from them.

BARROW, N^o II.

The perpendicular Height is about Eight Feet, Diameter, at the Base, about Thirty Feet, with a *Fossa* or Ditch round it: The Surface being removed, the Body of the *Barrow* consisted of the adventitious Earth, of a yellow Colour, and now-and-then some small Stones interspersed, not regularly; at the Middle we found a Pit of a cylindrical Shape, Two Feet broad, and One Foot and half deep, out of the natural Soil: Over the Pit we observed Three Stones placed edgeways, to cover the same, though nothing in it but some Earth of the *Barrow*, and Three small Stones.

BARROW, N^o III.

The perpendicular Height of the *Barrow* was Ten Feet and half, Diameter at the Base Forty-six, with a Ditch round it: Upon removing the Heath or Grass, (which was the common Surface to all the *Barrows*) we observed the same yellow adventitious Earth, which being penetrated a Foot through, we found a small Circle of Stones at *B*, which surrounded the *Barrow* [TAB. II. Fig. 1.]; then being passed through the same yellow Earth, we came to *C*, within Ten Feet of the Centre of the *Barrow*, where we found a *Stratum* or Lay of flat Stones, carefully laid flatways, to cover the rest underneath, as in the Roof of an Oven; which being taken off by the Six Tinnors, (whom an ingenious Gentleman of *St. Asulle*, and myself, employed on Purpose) a large Bed or Heap of Stones, irregularly and confusedly mixed together, and of various Sorts, appeared, and under them a large Number of Stones artfully placed and contrived, so as to form the Shape of a Cone,

their Points uppermost, and their largest Parts downward. Under this Heap we saw a Circle of Two Feet Diameter, equal in Height with the natural Surface of the Country, and caufwayed with small Stones laid edgeways, their sharpest Point downward; which Stones being taken up, we observed a cylindrical Pit at *D*, Two Feet broad, and Two Feet and half deep, cut out of the natural Soil, as the former; the Sides of the Pit were carefully lined round with these flat Stones, though none at the Bottom. We met with, first, some small Stones of various Shapes and Sizes, lying irregularly; under them appeared a black greasy Matter, but not above an Inch thick; some of the adventitious Earth had crept through the Crevices of the caufwayed Stones into the Pit. It deserves our serious Observation, that the Stones (which composed the Heap lying over the cylindrical Pit) were brought from Places both high and low situated, and many Miles distant from one another, as the *Par*, *Polmeor-Clif*, *Hainsbarrow*, *Pentuan*, and *Carnclays*, a high Hill, the Distance between some of these being Four or Five Miles.

B A R R O W, N^o IV.

Though we had hitherto found no Urn, yet being persuaded by the unctuous black Earth, and the cylindrical Pits, in the Centre of every one of the *Barrows*, the artful Position of the Stones to cover and guard them, and the foreign Earth, that these *Barrows* were crected for Sepulchres; we resolved to proceed farther, and pitched upon N^o IV. as one somewhat different from the rest, both as its Situation seemed to regard a greater Number of *Barrows*, and

as its Circumference appeared to have a very large Circle of Stones round it, without any Ditch or *Fossa*.

We began our Passage at *A* [TAB. II. Fig. 2.] through a Circle of Stones of Five Feet broad, and Two high; then we passed through adventitious Earth *B*, when we came to a Second Circle at *C*, of Stones of Three Feet high, and Three Feet broad; after them appeared nothing but foreign Earth, till we found, at the Centre *E* of the *Barrow*, an oblong square Pit, of the Depth of One Foot and half, and Breadth Two Feet, and Length Five Feet; in the Bottom appeared a black greasy Matter or Substance, as in the last *Barrow*, about an Inch thick; the Pit was not covered or defended by any Stones. However, being not satisfied, we examined the uttermost Circle of Stones, and on the Inside of it we struck on a great flat Stone, about Five Feet broad, and One Foot thick, under which, when lifted up, we found Two other thin flat Stones, and under them a smaller flat Stone, which covered an Urn, [TAB. II. Fig. 3.] which also stood upon another flat Stone in a small Pit, deeper than the Circle of Stones, and carefully wedged in, as well as supported, with many small Stones round it: This Urn is made of burnt or calcined Earth, very hard, and very black in the Inside; it has Four little Ears or Handles; its Sides are not half an Inch thick; in it were Seven Quarts of burnt Bones and Ashes; we could easily distinguish the Bones, but so altered by the Fire as not to be known what Part of the Skeleton they composed: The Urn will hold Two Gallons and more; its Height is Thirteen Inches and half, Diameter at the Mouth

Eight,

Eight, at the Middle Eleven, and at the Bottom Six and half.

Before we proceed any farther, a natural Observation will occur, in what Manner the Antients (that used Cremation, and all Nations of that way of Burial) expressed their Regard for the Deceased; and this plainly appears from the Structure of the *Barrows* or *Tumuli*, particularly N^o III. which is not only composed of foreign Earth, but of Stones brought from so many and so different Places; for, in erecting these *Tumuli*, the greater the Charge or Trouble, the greater must be the Respect due to their Princes or Generals. Thus each Soldier or Friend might bring some of the Earth or Stones from distant Places, where they lived, or were stationed, to compose the *Tumulus*, which generally was in proportion to the Greatness, Rank, or Power of the Deceased. Many Passages might be repeated from Authors of different Nations; but a few will not be tedious: Thus *Horace*, [*Lib. I. Ode 28. Carm.*]

*Quanquam festinas, non est mora longa; licebit
Injeto ter pulvere curras.*

Thus, again, we find *Achilles*, in *Homer*, complaining, how small a *Tumulus* he had made for his beloved *Patroclus*, [*Iliad. Ψ. v. 245.*]

Τύμβον δ' εἰ μάλα πολλὸν ἐγὼ πονέεω, ἄνωγ' αἶψα,
Ἄλλ' ἐπεικέα τοῖον, ὅς τις.

That these *Tumuli* were erected by pouring on Earth, or heaping up Stones, is plain from the Words so frequent in *Homer*, [*Homer, Iliad. Ψ. v. 257.*]
χέειν, χεύαντες τόδε σῆμα; and χερσὶν ἐχωννύμεθα, in the
Anthol.

Anthol. Epigr. Again, that they were composed of Stones, appears from the Words, *Λαίνοισι τ' ἐξοδκώμασι* in *Euripides*, and sometimes polished, *ξεστὸι τάφοι*, *τύμβος ξεστὸς*, from the same Author. Parallel to this, Mr. *Rowland's* Observation appears, who found a curious Urn in a *Carnedd*, or Heap of Stones, in *Anglesey* [*Mona Rest. pag. 49.*]. So the *Britains* had the same Custom of throwing Stones on the Deceased: Hence comes the *Welsh* Proverb, *Karn ar dy Ben*, I'll betide Thee.

So, again, Pillars of Stones were erected as Sepulchral Monuments, near the Ways, or in Memory of some Battle or Victory, as well as for Places of Religion and Sacrifices. I need not quote the Eastern Authors so well known; only observe, that they are frequent in *Cornwall* and *Wales*, were called *Meini Gwyr*, a Stone for Play, perhaps in Memory of Funeral Games, and sometimes *Llech*, i. e. *Tabula Saxeæ*: The following is a remarkable one.

A STONE PILLAR.

This large Stone is called by the Natives *Long Stone*, [TAB. I. N^o VI.] and stands upright on the Summit of the Downs, between the Highways after they are divided: The End fixed in the Earth has been examined above Eight Foot deep, but not discovered how much lower it lies; above the Surface of the Earth the Stone measures Thirteen Feet in Height, Three Feet in Breadth, and Two Feet and half in Thickness.

AN ENCAMPMENT.

An Encampment, about a Mile and half distant, shews itself [TAB. I. N^o XIII.]: It lies near the Cliffs, and overlooks *Par*, or *St. Austle-Bay*, by its high Situation: The Form is a true Circle, about an hundred Yards Diameter; the *Agger*, or Rampart, is very low; the Ditch is about Two Yards deep, and Five broad, imperfect towards the Sea, where the Ground has a great Declivity, and the Ascent to the *Agger* more difficult: It is called *Castle Gotha* [TAB. II. Fig. 4.]. However, to prevent the Influence which a false Interpretation might produce, we must observe, that *Gothys*, both in *Welsh* and *Cornish*, signifies High, or Proud; so that from *Kastelh*, or *Castellyn Gothys*, easily flows *Castle Gotha*, in the modern Dialect, as its Situation declares.

I have annexed a Map of *Par Bay*, [TAB. I.] (as copied from Mr. *Mitchel*, by a good Hand of our Dock) and of the Country, with the *Barrows*, Stone Pillar, &c. that this Essay may be rendered more intelligible. I have also been more nice in examining the internal Structure of these *Barrows*, as will appear by the Section and Ichnography of them. Because the best Authors have been contented with an external View of these *Tumuli*, but never penetrated the inmost Recesses, nor have we left any certain Characteristic to distinguish one Nation from another, I wish my Endeavours may give any new Light into this Affair.

It will be tedious and needless to enumerate what Nations burnt their Dead, and crected *Tumuli* over them; we must only remember, that it was the Custom among most Eastern Nations, and continued
with

with them, after their Descendents had peop'ed the most Western and Northern Parts of *Europe*: Hence it is easily traced in *Greece, Latium, Iberia, Gallia,* and *Britannia*, as well as *Germany, Sweden, Norway, Denmark*, till *Christianity* appeared, and abolished it.

Let us next consider what Nation or People inhabited, or were acquainted with, the most Western Part of *Britain*.

C E L T Æ.

That the *Celtæ* and *Britains* inhabited here, need not be proved; though, perhaps, I may hereafter trace their Relics or Remains of *Druidism* in *Carneds, Cromleches, Meini Gwys, Fortifications,* and the like.

PHOENICIANS and GRECIANS.

That the *Phœnicians* first, and after them the *Grecians*, knew these Islands, and traded here for Tin, long before the *Romans* Knowledge of them, is plain, and easily proved by *Grecian* and *Roman* Authors, as *Strabo, Polybius, Pliny, &c.* *Polybius* wrote a Book, *Περὶ τῶν Βρετανικῶν Νήσων, καὶ τῆς Κασιτέρας Κελαικῶν*. Which Book, though now lost, yet *Strabo* witnesseth, that therein he refuted the Errors of *Dicæarchus, Pythias*, and *Eratosthenes*, concerning the Magnitude of *Britain*, Authors much older than himself. And though Disputes may arise, whether the *Bratanac* of the *Phœnicians* gave Name to these Islands, yet it is certain, that the *Greeks* knew them under the Title of *Cassiterides*, the Tin-Islands.

But whether these Nations were ever sett'ed here as Inhabitants, and became Bodies Politic, to erect

Fortifications, Towns, Cities, Encampments, and the like, is without any Certainty. Indeed a learned, and no less laborious Author, [*Sammes's Britan.*] has endeavoured to derive the Names of Places, Customs, Religion, Art of War, Language and Government of the antient *Britains* from the *Phœnicians* being settled here; and this only upon a supposed Affinity between some *British* and *Phœnician* Words, and their Trade for Tin: But by the same way of Reasoning, we might as well and easily prove, that the *Phœnicians* received these very Words from the Descendents of *Gomer*, the *Celtæ*, before they passed over the *Hellepont*; and also that the *British* or *Celtic* Words, which occur in the *Grecian* and *Roman* Languages, are derived and owe their Origin to the same People as they journeyed Westwards, and sent Colonies to different Parts to inhabit them, particularly the most South; the Northern Parts being peopled by the Descendents of *Askenez*, *Gomer's* Son: Hence the *Teutonic* Language flows, though not without some Affinity to the *Celtic* in few Words.

R O M A N S.

That the *Romans* conquered great Part of *Britain*, is not disputed; but whether they possessed the most Western Part, now *Cornwall*, many Learned doubt. Let us enumerate the chief Arguments and Proofs for it: The Geography and Figure of *Britain* is delivered in various *Grecian* and *Roman* Authors, and the most Western Part is not forgot. *Cæsar*, the first *Roman* Invader, mentions the triangular Form of the Island, [*Comment. Lib. v.*] *Insula est triquetra;*

quetra; unum latus est contra Galliam, alterum vergit ad Hispaniam & solem occidentem, qua ex parte est Hibernia; tertium est contra septentrionem. But, out of a great many, let us hear *Ptolemy Geograp. Lib. II.*

Νήσῳ Βρεττανικῇς θέσις.—Δυσμικῇς πλῆρ᾽ αἰς περιγραφῇ, ἢ παρὰ κείλαι, ὅτε Ἰσθμῶν ὠκεανός, καὶ ὁ Οὐερλίαι.— Ἡρακλέους ἄκρον, Ἀντιέστειον ἄκρον, τὸ καὶ Βολέρειον· Δαμνόνιον, τὸ καὶ Ὀκρινον ἄκρον· τῆς ἐφεξῆς μεσημβρινῆς πλῆρ᾽ αἰς περιγραφῇ, ἢ ὑπὸ κείλαι Βρεττανικὸς ὠκεανός, καὶ τὸ Ὀκρινον ἄκρον· Κενίων πόλιν ἐκβολαί, Ταμάρ πόλιν ἐκβολαί, Ἰσάκα πόλιν ἐκβολαί. And again: Μεθ' ἧς [Δυρότριγας,] δυσμικῶταί Δαμνόνιοι, ἐν οἷς πόλεις Οὐολίβα, Οὐξέλα, Ταμαρῆ, Ἰσκα. Λεγεὼν δευτέρα Σεβαστή.

Which may be thus translated: “ After the Po-
“ sition of the *British* Island, let us survey the
“ Western Side, which lies along the *Irish* and *Ver-*
“ *givan* Seas, where lie the Promontory of *Her-*
“ *cules*, the Promontory *Antivestæum*, sometimes *Bo-*
“ *lerium*, the Promontory *Damnonium*, called also
“ *Ocrinum*; and in the Side towards the South, and
“ bounded by the *British* Ocean, after the Promon-
“ tory *Ocrinum*, the Rivers *Cenion*, *Tamar*, and *Isca*,
“ discover themselves, by discharging themselves into
“ the Sea.” The Coast and Rivers being mentioned,
next described are the Cities. “ The most Westward
“ after the *Durotriges*, are the *Damnonii*, among
“ whom are these Cities (πόλεις); *Voliba*, *Uxela*,
“ *Tamare* and *Isca*, with the *Legio Secunda Au-*
“ *gusta*.” *Ptolemy of Alexandria*, under the Reigns
of *Trajan*, *Hadrian*, and *Antoninus Pius*, wrote
his Geography. In the *Iter Britan. Antonini*,
Itiner. xii & xv. supposed to be composed or

begun in the Times of *Antoninus Pius* or *Caracalla*, Mention is made of *Dumovaria*, *Moriduno*, * *Scadum Nunniorum*, *Leucaro*, *Bomio*, and *Nido*, *Iter XII.* and in *Iter XV.* of *Dumovaria*, *Moriduno*, *Isca Dumnoniorum*. That by these last-mentioned Names are meant *Dorchester*, *Seaton*, and *Exeter*, is generally allowed; though whether *Leucaro*, *Bomio*, and *Nido*, are to be traced in *Damnonium*, may admit of a future Inquiry. The *Notitia Romana*, supposed to be written at the End of *Theodosius* the younger, is indeed silent in respect to the most Western Part of *Britain*, then called *Flavia Cæsariensis Britannia*, but seems principally to regard the Eastern and Northern Coast, the *Littus Saxonicum*; the *Roman* Soldiers being then withdrawn to these Parts, to defend the Island against the Invasions of the *Saxons*, and Inroads of the *Picts*.

In the *Chorographia Britanniae Ravennatis*, supposed to be compiled by *Gallio*, the last *Roman* here with any Command or Forces, we have this Preface: *In Britannia plurimas fuisse legimus Civitates & Castra, ex quibus aliquantas designare volumus, Tamaris, Uxelis, Scadum Namorum, juxta quam civitatem est Moriduno*: Allowed by all Commentators to be *Tamerton*, *Lestwithiel*, *Exeter*, and *Seaton*. Again: *Currunt autem per ipsam Britanniam Flumina plurima, ex quibus aliquanta nominare volumus, i. e. Tamaris, Tamer, Isca Ex, Tamion Tavy, Leuca Low, Dorvatium Dart, Antrum Arm, Vividin Foy or Foath of the Britains*. Most Interpreters allow the *English* Names agreeably translated to the *Latin*.

* Which is only a false reading for *Isca Dumnunniorum*.

In the *Tabula Theodosiana* or *Peutingeri*, supposed to be made about the Time of *Theodosius the Great*, occur Two Stations, *Isca Dumnoniorum*, *Riduno*, which exactly answers to *Isca Dumnoniorum* and *Moriduno* of *Antoninus*.

More might be extracted, to prove that the Geography of *Dumnonium* or *Danmonium*, was well known to the *Romans*. But let us now consider, that since the *Isca Dumnoniorum* is said by *Ptolemy* to have the *Legio Secunda Augusta* stationed at it, and so great and exact Account is given of the *Civitates* (πόλεις) & *Flumina*, in the same Author, as well as *Antoninus*, *Chorographia Ravennatis*, and *Tabulae Peutingeri*, can we suppose, that the *Romans* could be ignorant of the Tin the Product of *Danmonium*, so often mentioned in the *Grecian* Authors? and since that their own Name of *Dummonium** was by themselves changed from the *British*, *Dun Mwyn*, a Hill, or Country of Metals; agreeable to which Etymology we have at this Day a Place abounding in Metals, called *Mwyn*, as *St. Mwyn* Parish, within Two Miles of the above-described *Barrows*. Besides, it must be contrary to Reason, and the *Roman* Genius, [*Vita Agric.* Sect. 12.] (*Nobis nec deest Avaritia*, says *Tacitus*, their own Countryman) to imagine, that the *Romans*, called *Raptores Orbis*, (by the same Author) should neglect to hunt after the Metals of Tin and Lead, which were valued as the Rewards of Victory. *Tacitus* has a beautiful Passage to this Purpose, [*ib.* Sect. 12.] *Fert Britannia Aurum & Argentum, & alia Metalla, pretium Victoriæ*. Again: I hope it will not be tedious to make some Extracts out of *Galgacus's* Speech to his Army, going to

* Rather *Dunmōnium* q. s. *Dun mwyn* *inm.*

encounter the *Roman* Eagle, and when the *Roman* Fleet had furrounded and created Terror to *Caledonia*: *Nulla ultra Terræ, ac ne mare quidem securum imminente classe Romana.*—*Nunc terminus patet: Romani, — Raptores Orbis, — avari, — & ambitiosi, quos non Oriens, non Occidens satiaverit, — bona fortunæque in tributa egerunt; in annonam frumenta, corpora nostra ac manus sylvæ & paludibus emuniendis verbera inter & contumelias conterunt; — neque sunt nobis Arva, aut Metallum, aut Portus, quibus exercendis reservemur: — hic Dux, & exercitus ibi, tributa, & metalla, & ceteræ servientium pænæ.*—Perhaps the Curious have not sufficiently remarked this beautiful Speech of *Galgacus*, where he so pathetically lays before them the Loss of their Support, the Metals, for which the *Romans* so eagerly fought, and hazarded their Lives, as the expected Reward. He likewise relates the Fear created by the Appearance of the *Roman* Fleet on their Coasts. If we reflect again, that the *Roman* Fleet not only sailed round *Caledonia*, but also the *Dunmonium*, when the *Roman* Ships went to attack the *Silures* in *Wales*; and that the Name *Dun Mwyn*, must declare the Product of the Country, as Authors did likewise; and that the Second Legion was stationed at *Exeter* the Capital City; could the *Romans* in an unusual Manner sit idle, and forget their darling Metals, and not penetrate the most secret Places?

It will be a Digression, but I hope not an impertinent one, to confute a vulgar Error, that the *Roman* Soldiers made the Highways in *Britain*; when it is plain, that the poor conquered *Britains* under them, as Masters and Overseers, & *inter verbera &*
con-

contumelias, caufwayed the Bogs, and pared Woods; *Paludibus & Sylvis emuniendis*, are *Tacitus's* Words: This was the unhappy State of our conquered Ancestors the *Britains*.

Much more might be faid from the Metals: Let us take a Remark from the Language, and this is one of the Learned Mr. *Edward Llwyd's*, who fays, [*Archæol. Brit.* p. 32.] that the *Dunmonian* and other Southern *Britains*, being, on account of their Situation, earlier conquered by, and confequently more converfant with the *Romans*, than we of *Wales*, it is not to be wondered, if feveral *Latin* Words occur in the *Cornish* Dialect not owned by the *Welsh*, as *Cornish* Splender, *Latin* Splendor, *Welsh* Eglyrder, *Cornish* Glitis, *Latin* Glacies, *Welsh* Jâ, *Cornish* Bovin, *Latin* Bovina, *Welsh* Kigeidon, &c.

If we trace the *Romans* by their Remains, as Caftles, Camps, Coins, Amphitheatres, we may probably be very lucky. Thus we obferve Three circular Camps or Fortifications within a Mile and half of *Grampound*, the *Voluba*, which lies in the Centre of them. They have a fingle *Agger*, and a Ditch: In the Rampart of one of them was found an Urn fome Years fince, but broken by the Workmen: Another Caftle *Dennis*, where there is a triple Rampart and Ditches, which has a Caufway leading to it peculiar to the *Romans*; and I am informed of an Amphitheatre at *Torran* in *Zabulo*: But I fhall not dwell longer, at prefent, on this Subject; but mention a very weighty Argument from Coins found in the moft Western Part of *Dunmonium*. The Firft were found in *Manacon* Parifh near *Helford* River, and not many Miles from the *Ocrinum Dunmoniorum*,
Li-

Lizard-Point. I have had the Sight but of Three, which are Copper, and of a small Size, very fair and legible: I had them from a Friend at *Falmouth*.

1. *Constantinus jun. Nob.* Reverse *Corona Civica.*
2. *Constantius* *Provident Caes.*
3. *Constantius Nob.* *Gloria Exercitus.*

On the other Side of *Helford* River in the Parish of *Constantine*, last Year, a labouring Man at Plough turned up about Forty, or more: I have seen about Thirty of them, Six of which are Silver, and the others Copper. The Silver ones are very fair and beautiful, and about the Bigness of a Farthing, or the *Roman Denarius*, and are these:

- | Silver. | Reverse. |
|--|---|
| 1. <i>Imp. Caesar Vesp. Aug.</i> . . . | <i>Pontif. Maxim.</i> |
| 2. <i>Hadrianus Aug.</i> | <i>Cof. III.</i> |
| 3. <i>Divus Antoninus.</i> | <i>Divo Pio.</i> |
| 4. <i>Imp. Cæs. Nerva Trajan. Aug.</i> . . . | <i>P. M. TR. P.</i>
<i>Cof. III. P. P.</i> |
| 5. <i>Divæ Faustina.</i> | <i>ugus. . other</i>
<i>Letters defaced.</i> |
| 6. <i>Imp. M. Jul. Philippus Aug.</i> . . . | <i>Annona Aug.</i> |
- Copper.


Six in Number, the Size larger than a Halfpenny, and near the Weight of the *Roman As* of half an Ounce, scarce legible.

1. *Imp. Cæsar Domit. Aug.* } . . *Augusti.*
Germ. Cof. XIII.
2. *Antoninus Aug.*
3. *Nerva Trajan. Aug.*

The Reverse not legible, except one Word *Augusti*.
 Three more of the same Size, intirely defaced.

Copper Coins.

Five in Number, about the Bigness of a Farthing.

1. *Constantius Jun. Nob.* Reverse *Fel. Temp.*
2. *Constantius.*
3. Seems to be a Head }  the *Labarum*, I take,
of *Constantine.* } of *Constantine.*

The other Two defaced.

Twelve in Number, less in Size than a Farthing,
or *Triens* or *Quadrans* of the *Roman As*, of which

- 4 *Constantinus.* *Gloria Exercitus.*
- 2 *Constantinus Aug.* *Votis x.*
- 1 *Constantinus.* *Roma.*
- 1 *Constantinus Jun. Nob.* *Providentia Caf.*
- 1 *Aug.* *Oriens Aug.*

Three others not intelligible.

These Coins are in the Custody of my Friend Dr.
Russel of *Truro*. If I had Leisure, perhaps I might
have been nice in discovering the Faces and Reveries:
This Gentleman informs me, that near the Place
where the Coins were found, is a circular Camp near
Helford Harbour.

D A N E S.

I could have longer dwelt on this Subject, but
have been tedious already: However, must not forget
the *Danes*, who certainly landed here in *Cornwall*,
but by Invitation from the *Britains*, to assist them
to overcome the *Saxons*, and probably never had
any Settlement here: They, as Friends, did not want
Fortifications for their Defence in *Cornwall*, since
they went as far as *Exeter* with the *Britains* against
the *Saxons*, who could never penetrate *Cornwall* till
the Ninth Century, when, by one fatal Battle, the
Britains were obliged to become Tributaries. This

Battle was fought near *Lanelford*. Several Places, I am satisfied, supposed to be *Danish* by the Names, never did belong to them. Thus, to instance in One, *Carlle Dennis*, which is certainly a *British* and *Cornish* Name; *Kastelh Ennys*, or *Castellyn Enny*, signifies a Castle on an Island, or in the Form of one either moated or trenched round, and here are Three Trenches. Again; *Pendennis* might, for the same Reason, be reckoned *Danish*, when *Pedn*, or *Pen Ennys*, in *Cornish*, signifies the Head of an Island, or a Peninsula.

I have endeavoured to trace all the Nations, which could be supposed to have known *Cornwall*; and must leave it at present to Gentlemen more learned, to conjecture and discover what Nation erected these *Tumuli*. My Efforts have been to prove myself as worthy a Member as I can, and to thank the ROYAL SOCIETY for the Honour done to me at my Election. If these Papers meet with a favourable Reception, it may encourage to proceed farther about the Antiquities in this Country.

S. Williams.

References to TAB. I.

Nº I, II, III, IV. *The Barrows on the Down, which were opened: In the last was found the Urn.*

v. *A Barrow, whose Position respects a larger Number, as Nº IV. does the others lying Eastward of it.*

vi. Long Stone.

vii. St. Auffle.

. . . viii. *The*

VIII. *The Road to Grampound, after its Division near the Barrows,*

IX. *and near Grampound it meets the other Branch (VIII) again.*

N.B. *There is not any other convenient Road between Uxella, Leftwithiol and Voluba, Grampound*

X. *Road to Uxella, or Leftwithiol.*

XI. *Road to Foy, or Vividin.*

XII. *A Brook of Water.*

XIII. *Castle Gotha.*

XIV. *Hills.*

TAB. II.

Fig. 1. *The Section and Ichnography of Barrow, N^o III.*

A. *The Circumference of the Barrow.*

B. *A small Circle of Stones.*

C. *The Body of Stones, which lay over the cylindrical Pit.*

D. *The cylindrical Pit.*

E. *The Earth of the Barrow.*

F. *The Passage cut by the Workmen.*

The Diameter of the Barrow was 46 Feet.

The perpendicular Height $10\frac{1}{2}$ Feet.

Fig. 2. *The Section and Ichnography of Barrow, N^o IV.*

A. *The First Circle of Stones.*

B. *Earth.*

C. *The Second Circle of Stones.*

D. *Earth.*

E. *The Centre.*

F. *The oblong Pit.*

- G. *The Passage cut by the Workmen.*
 H. *The Place where the Urn was found.*

Fig. 3. *The Urn.*

Its Height was $13\frac{1}{2}$ *Inches.*
Diameter at the Mouth 8 *Inches.*
at the Middle 11.
at the Bottom $6\frac{1}{2}$.

Fig. 4. *The Plan of Castle Gotha.*

- A. *The Diameter of the Camp, 100 Yards.*
 B. *The Rampart [Agger.]*
 C. *The Ditch, Five Yards deep, and Two Yards broad, which reaches no farther than D D. where there is a falling away of the Ground towards the Sea.*

IV. *Extracts of Two Letters from Sig^r. Camillo Paderni at Rome, to Mr. Allan Ramsay, Painter, in Covent-Garden, concerning some antient Statues, Pictures, and other Curiosities, found in a subterraneous Town, lately discovered near Naples. Translated from the Italian by Mr. Ramsay, and sent by him to Mr. Ward, F. R. S. Prof. Rhet. Gresh.*

SIR,

Rome, Nov. 20. 1739.

YOU may remember, I told you in one of my former Letters, that the King of Naples was become a *Virtuoso*, and had made a Discovery of a sub-

subterraneous Town at *Portici* †, a small Village at the Foot of Mount *Vesuvius*; and that our old Friend Sigr *Gioseppe Couart*, as Sculptor to the King, had the Care of the Statues found there, with Orders to restore them, where they are damaged. Within these few Days he is returned hither to settle his Affairs, and has informed me of some of the Particulars, in such a Manner as very much incites my Curiosity, and Desire of communicating them to the Public, by making Designs of them on the Spot. He tells me, they enter into this Place by a Pit, like a Well, to the Depth of Eighty-eight *Neapolitan* Palms *; and then dig their Way (after the Manner of our *Catacombs*) under the bituminous Matter, thrown out of the Mountain in the Time of great Eruptions, and called by the People of the Country, the *Lava*, which is as hard as a Flint. And when they meet with any thing that seems valuable, they pick it out, and leave the rest. But I am afraid, that after they have searched, they throw the Earth in again; by which means many Curiosities may be lost, not being understood by these Labourers. They have already found the following Things:

An Amphitheatre, with its Steps.

An Equestrian Statue, but all broken to Pieces.

A Chariot and Horses of Brass, which have had the same Fate.

A large brazen Dish, said to be found in a Temple.

They have also dug out many other Bronzes, with several Statues and Bas-relieves, which Sigr *Gioseppe* is now restoring.

† See these *Transactions*, N^o 456. p. 345.

* A *Neapolitan* Palm contains near Nine Inches.

There have been found likewise Eight Rings with their Cornelians engraved, and a Bracelet of Gold.

And they have already taken up about Thirty or more Pieces of antient Painting, some of which are exceeding beautiful.

Sigr *Gioseppe* gave me a Note of the Pictures, but as it is in *Spanish*, and wrote in a very bad Hand, I cannot pretend to transmit it to you; but choose rather to defer it, till I have seen them myself, which shall be as soon as I have finished a Piece of Work I am now about, &c.

S I R,

Rome, Feb. 20. 1740.

AS soon as I arrived at *Naples*, Sigr *Gioseppe* met me, and carried me to *Portici*. The first thing he shewed me was the Pictures they had dug out, such as never were seen in our Days; and were you to see them, you would be surpris'd as much as I was; for you would see Paintings finished to the highest Pitch, coloured to Perfection, and as fresh as if they had been done a Month ago.

Particularly one Piece, Eight Palms broad by Nine high, the Figures as big as the Life, representing *Theseus* after having killed the *Minotaur*, which is wonderfully fine. You see the Figure of *Theseus* naked and standing, which, in my Opinion, cannot be more properly resembled to any other thing, than the *Antinous* of the *Belvidera*, both for the Attitude and Air of the Head. It is drawn and coloured with prodigious Elegance. The *Greek Boys*, who are represented as returning him Thanks for their Deliverance, seem, for their noble Simplicity, the Work
of

of *Dominichino*; and the Composition of the Whole is worthy of *Raphael*.

Another Piece represents *Chiron* teaching *Achilles* to touch the Lyre.

Another large one, like that of *Theseus*, the Figures as big as the Life; but we could not comprehend the Design of it. You see a Woman dressed in White sitting, with one Hand resting on her Head adorned with a Garland of Flowers, and several Deities (as they appear to me) in the Air, with a black Figure of *Hercules* leaning upon his Club. This Figure is not of a Piece with the rest, which are really Prodiges of the Pencil; but yet it is a fine Picture. Under the Woman is a Deer, which gives Suck to a Child. But was you to see this sitting Figure, and the Heads of those whom I take to be Divinities, how finely they are drawn and coloured, you would be astonished.

Two other Pieces of greater Height than Breadth, in which there are Two Figures, half Human and half Fish, which fly in the Air.

Four Landskips, with Temples, and other Buildings.

Another Figure, which we think to be *Mercury*, with a Child in his Hand, delivering it to a Woman sitting.

A *Tyger*, with a Boy upon it; and another Boy, who plays on a *Tympanum*: With many others.

After having viewed all these things, which are already taken out, I went down into the Pit. The Part where they are at work, must have been a stupendous Building; and without doubt one may conjecture it to have been an Amphitheatre, by the
Cir-

Circumference of the Walls, and the large Steps, which are still preserved. But it is impossible to see the Symmetry of the Whole; because one must travel through streight Passages, like our *Catacombs* in *Rome*. After having gone a good Way under-ground, I arrived at the Place in which the Paintings had been discovered, and where they are daily discovering more. The first Mistake those Men they call Intendants have committed, is, their having dug out the Pictures, without drawing the Situation of the Place, that is, the Niches, where they stood: For they were all adorned with Grotesques, composed of most elegant Masques, Figures, and Animals; which, not being copied, are gone to Destruction, and the like will happen to the rest. Then, if they meet with any Pieces of Painting not so well preserved as the rest, they leave them where they found them. Besides, there are Pillars of *Stucco* extremely curious, consisting of many Sides, all variously painted, of which they do not preserve the least Memory. But what is most curious, is to see these Paintings all covered with Earth, which when taken off, they appear to have suffered nothing by it. I believe this may be accounted for, by there being no Damp or Moisture in the Place; and that the dry Earth has been rather preservative, than hurtful to them. The ancient Beams are yet discernible, but they are become like Charcoal. And I have seen there a Place where antiently they kept Lime for building; a great Quantity of which yet remains as fresh as it made but Yesterday. In a word, perceiving all those who are called Superintendants of this Affair, wholly ignorant of what they are about, I began to suffer in

a very sensible Manner; so that every Day appeared a Month, till I should deliver my Letter, and see what Success it would meet with. For had it succeeded, I should have gone immediately, and drawn those Things, which, not being taken care of, though of great Curiosity and Erudition, will soon be destroyed.—However, as I could do nothing more, and having a great Concern for those fine Things in a perishing Condition, I left them a Paper of Directions how to manage. If they do not observe them, the greater Misfortune will be ours, to hear that what Time, Earthquakes, and the Ravages of the Volcano have spared, are now destroyed by those who pretend to have the Care of them, &c.

V. *Extract of a Letter from Mr. George Knapton to Mr. Charles Knapton, upon the same Subject.*

I Shall not trouble you with any Account of the Curiosities of *Naples*, they being so well known, only of one which is something out of the common Way, the antient City of *Herculaneum*, which was swallowed up by an Earthquake. It is now under a Town called *Portici*, a quarter of a Mile from the Sea, at the Foot of *Vesuvius*; and has no other Road to it, but that of the Town-well, which is none of the most agreeable, being in some Parts very straight, in others wide, and cut in a most rude Manner. Toward the Bottom, where you go into the City, it is very broad, which they have made so, to turn the

Columns, which were brought up: For I spoke to an old Man, living next Door to the Well, who told me, he was one of those employed in digging there; and that they began 27 Years ago, and worked Five Years: That the best Part of the Duke *di Belbofi's* present Estate was found there; the most principal Things were, Two Columns of Oriental Alabaſter, which were ſold for 50,000 Ducats: That they had found alſo many fine Statues, the beſt of which were ſold, and ſome he had ſent to *Lorraine*. I ſaw Five, which they have put up in the Market-place, all clothed Figures, one in a Conſular Habit, the others Women: They are all well dreſt, and in a fine Taſte, but want the Heads. In the Duke's *Villa*, which is near and by the Sea-ſide, are Two others intire, both Women; one ſeems to be a *Livia*: Alſo the Fragments of a naked Figure, which wants the Head and Arms, of a good Style. Theſe, with ſome Ornaments and Fragments of various ſorts of Marbles, are all that is to be ſeen there, of what has been dug up.

Having given you ſome Account of what is taken out of this ſubterraneous City, I ſhall now proceed to what remains in it, and our Journey down to it. At our coming to the Well, which is in a ſmall Square, ſurrounded with miſerable Houſes, filled with miſerable ugly old Women, they ſoon gathered about us, wondering what brought us thither; but when the Men who were with us, broke away the paltry Machine with which they uſed to draw up ſmall Buckets of Water, I thought we ſhould have been ſtoned by them: Till, perceiving one more furious than the reſt, whom we found to be *Padrona* of the Well,
by

by applying a small Bit of Money to her, we made a shift to quiet the Tumult. Our having all the Tackle for descending to seek, gave Time for all the Town to gather round us, which was very troublesome: For, when any one offered to go down, he was prevented either by a Wife, or a Mother; so that we were forced to seek a motherless Batchelor to go first. It being very difficult for the First to get in, the Well being very broad at that Part, so that they were obliged to swing him in, and the People above making such a Noise, that the Man in the Well could not be heard, obliged our Company to draw their Swords, and threaten any who spoke with Death. This caused a Silence, after which our Guide was soon landed safe, who pulled us in by the Legs, as we came down. The Entrance is 82 Feet from the Top of the Well: It is large, and branches out into many Ways, which they have cut. We were forced to mark with Chalk, when we came to any Turning, to prevent losing ourselves. It gives one a perfect Idea of a City destroyed in that Manner: For one there sees great Quantities of Timber, in the Form of Beams and Rafters, some lying one Way, some another; some, as they broke in the Fall, others intire: These are sticking in the Sides of the Ways, and are become a perfect Charcoal; but those in moist Places, and where the Water oufes, you may run your Hand into, and work like a Paste, and they have more the Colour of rotten Wood. The Walls are some tumbled slanting, others crossing them, and many are upright. One sees great Quantities of Marble, as Bits of Window-cases and other Ornaments, sticking out on all Parts. There seem to be, in

one Place, the Ruins of some magnificent Building, which they have dug round; for there appear the Bases in white Marble of square and round Columns, which are all of a Size; and, what is surprising, they have not examined whether they have any Columns on them, which one Stroke of the Pick-ax would have done. I scraped away the Earth at the Side of the Base of a Pilaster, and found the Wall covered with a very beautiful Marble, but could not reach to discover what was on the Top of it. There are but Two Columns that appear, one of a red Marble, the other of Brick covered with Stucco, and fluted. In one Place there are about 14 Steps, which resembled the Seats of a Theatre. Some of the Walls have the Plaster remaining, and are painted, the Colours still fresh. *We found many Ways filled up, which they had done to save the Trouble of carrying out the Earth.* I observed that they had not gone near the Bottom of the Ruins, for fear, I suppose, of the Springs; for in some Parts they seem to be as low as the Water in the Well. One sees nothing but pure Earth mixed with these Ruins; whereas the Surface of all that Part of the Country, quite to the Sea, is covered with the Cinders of *Vesuvius*. One sees the Buildings were of Brick covered with Marble; for I found no other sort of Stone there, but thin Plates of Marble of all sorts in great Quantity. Neither are there any Bases or Capitals of large Columns; Two Feet Diameter is the most. Captain *Emmory* brought away a small Capital of a Pilaster, which is very curious; it being much the same as was used by the *Goths* in *Italy*. This makes me think, that they revived the ancient

barbarous Style, used before the Introduction of the *Greek*, for the Capital: This is certainly more antient than the Time of the *Goths* in *Italy*. It was the only one of the kind we saw there.

VI. *Extract of a Letter from Mr. Crispe to Mr. George Knapton, upon the same Subject as the Two preceding Papers.*

Rome, April 24. 1740.

AT *Portici* I saw some antique Paintings, which have lately been taken out of the Ruins of *Herculaneum*: Two of them, about 12 Feet Square, with their painted Frames or Borders round them, are as fresh and perfect as if done Yesterday; much more so, I assure you, than some of *Raphael's* in the *Vatican*; and for Excellence, and fine Taste, they are, I think, beyond any thing I have seen. One of these is called the *Pomona*, because, among other Figures, there is a Woman sitting crowned with Fruits and Blossoms. The other is *Theseus*, having just killed the *Minotaur*, who lies dead at his Feet; a Figure of a Youth is kissing his Right Hand; *Ariadne* and another Figure stand at his Left. The Figures in both these are as big as Life. There is a Third, somewhat less, of *Chiron* teaching *Achilles* on the Harp, if possible, still beyond the Two former. There are above 50 other Pieces, some whole Figures, some Heads, some *Mascheras*, some Landskips, some Architecture.

I was to visit the Ruins under-ground, where I saw several Pieces that were taking down; particularly

cularly one 15 Feet wide, and Eight high: It consists of the Front of a large Temple, with Buildings of the same Architecture projecting on each Side, in the Nature of the Wings of a House. There are Houses also adjoining to this Temple, with Windows divided into Squares, which Squares are painted of a greyish Colour: I will not pretend to say, this is to represent Glass, because I believe we have no Authority for it in any Author of Antiquity: But I tell you the Fact as it is, and among the *Virtuosi* of your Acquaintance you may find out the Meaning. I must observe to you, that in this Architecture the Perspective is very exact; which one may judge of with a good deal of Certainty in those Wings which project. The Architecture is very rich and noble: The *Clair-Obscur* likewise in the other Pictures, is well understood; particularly in the *Pomona*, where there are Six Figures, which are very agreeably grouped, and the Eye is immediately pleased and reposed. They have dug up a good many Statues, but not above One or Two that are tolerably good. There is, however, a perfect Bust of *Agrippina*, Mother of *Nero*, which was found standing in its Niche: It is as clean as if just finished, has not the least Damage, and is, in the Judgment of every body, as well as myself, equal to most things of that kind in the World: For my own Part, I should not stick to say, it is altogether as fine a Portrait as the *Caracalla* of the *Farnese*. There are Two Equestrian Statues in Bronze, broken all to Pieces, but which, by the Parts, one may judge to be as big as the *Marcus Aurelius*: They are soon to be put together. They have found several antique Rings, with *Cameo's* and *Intaglia's* set in them; a Fork,

Fork, a Silver Spoon, made in the Handle like a modern one; the Bowl is pointed like an Olive-leaf; a Case of Surgeon's Instruments, several Kitchen Utensils, Mouse-traps, Vessels full of Rice, a Triumphant Car of Bronze, &c.

VII. *A remarkable Cure performed by John Cagua, Surgeon, at Plymouth-Dock, of a Wound of the Head complicated with a large Fracture and Depression of the Skull, the Dura Mater and Brain wounded and lacerated: Communicated in a Letter to William Cheselden, Esq; F. R. S. &c.*

JUNE 11. 1729. I was sent for to Mr. John Darton of Stonehouse near Plymouth, to see his Son, aged 10 Years, who fell down from the Top of an old Wall, as he was taking out a Sparrow's Nest, upwards of 20 Feet high, in an antient Building belonging to the Honourable Richard Edgewcombe, Esq; When I came, I found him speechless, comatose, bloated Eyes, a wan Face, bleeding at the Nose and Ears, and a great Hemorrhage and Vomiting: On Examination, a large, long, deep, and contused Wound appeared, from the Eyebrow all over the Left Side of his Head; and after having shaved him, was surprised to feel, with my Fingers, so many rugged Splinters of the Cranium confusedly depressed through the Dura and Pia Mater into the Substance of the Brain; the Extremities whereof
ap-

appearing above the *Dura Mater*, I extracted to the Number of Five, as they are represented in the Draught (*see* TAB. IV.) in their proper Bigness and Figures, besides several other Bits and small Pieces: In taking out the last Splinter, being Part of the superior and interior Part of the Orbit, containing some of the Basis and inferior Part of the *Os Frontis*, joining by the *Sutura Transversalis* to the superior Part of the *Os Alae*, with Part of the said *Suture* and the upper Extremity of the *Sphenoides*, almost to the lower End of the *Sutura Coronalis* and *Squamosa*: This Splinter was the major Part of it depressed under the superior Part of the great Depression of the *Os Frontis*; on extracting of which, Two Parts or Pieces of the Substance of the Brain, with clotted Blood, came out with it, one as big as a large Kidney Bean, and the other as a large Pea; at which Time the Patient fainting and vomiting, brought up most of what was contained in his Stomach, mixed with bilious and bloody Matter. The *Dura Mater* was very much contused, lacerated, and bare, upwards of Three Inches and a quarter in Length, and at one End One Inch and a half over, the Remainder about One Inch, and the Edges rugged: From the upper Part of the Fracture, there was a Depression of the *Os Frontis*, which reached up to the *Sutura Sagittalis*, nigh the *Coronal Suture*: One Part of the *Cranium* lapt over the other, which I sawed off on the Third or Fourth Day, it being an Inch long, and occasioned me a great deal of Trouble, before I could raise it up with my Elevator, the inferior Part of the Fracture being so thin and weak: The depressed Part terminated in a long Fissure, about an Inch behind the *Coronal Suture*

ture in the *Bregma*: The *Scalp* was so much confused and lacerated, that the next Day it began to mortify, which obliged me to lay all that Side of the *Coronal*, and the greatest Part of the *Bregma*, home to the *Lamdoid Suture*, bare, from the upper Part of his Head down to his Ear (as in TAB. III.): The *Dura* and *Pia Mater* were very livid, and insensible to the Touch, except those Parts where the Brain was wounded, in the dressing of which the Motion or Pulsation of the Brain was very strong, and sometimes to that Degree, that it would rise considerably above the Surface of the *Cranium*; which obliged me to keep it down sometimes more than Two or Three Minutes with my Fingers, and a large and thick Sindon dipt in a warm detergent Lotion, before it would cease, introducing it between the *Dura Mater* and the Edges of the Fracture. The upper Eye-lid in a Week's time impostumated, and formed a large Tumor as big as a Hen's Egg, which I opened, and kept it so a considerable Time, because I had therefrom a plentiful Discharge of Matter, which was at first very fetid, but afterwards became laudable, giving likewise a good Discharge from the wounded Brain through the Fracture of the upper Part of the Orbit. In about a Fortnight's time I had a very laudable Suppuration from all the Wound, and the Symptoms ceasing, the *Dura Mater* began to regenerate, looking very red and fresh; the livid and lacerated Parts flust off, and the Extremities of the Fracture began to throw out their Ossifications from the *Diploe* and both Tables of the *Cranium*, like small Excrescences, or proud Flesh, which in a Month's time spread over the whole Fracture; and I made my Observation, that it grew

S f f

harder

harder sooner at the Extremities of the Fracture than in the Centre The Motions or Pulsations of the Brain still continued, and were very visible for a long Time after, and were felt for some time after the Wound was cured; especially in the inferior Part of the *Coronal* and *Bregma*, over the inferior Part of the *Coronal Suture*, nigh the *Squamosa*. Except the Three or Four first Days, the Boy continued very sensible; but during the first Six Weeks would very often complain of a violent Pain in his Head, attended with a *Comatose*, and Fever; but would soon go off again, by giving him an emollient and laxative Clyster, or a gentle laxative Draught. The 6th of *October* following, before his Wound was quite well, he was taken very ill with the Small-pox, of the Flux-kind, and though he had them very severe, and delirious in their coming out, yet recovered. The 11th of *November* following, the Wound was perfectly cured; but in the latter End several Exfoliations were taken out of the upper Part of the *Coronal*. He is now, and hath been ever since, very well, strong and healthy; has his Sight in both Eyes, is a very sensible and forward Lad, for his Age, and has been upwards of Four Years at Sea, in his MAJESTY'S and the Merchants Services.

Plymouth-Dock,
March 1. 1736.

John Cagua.

T A B. III.

Represents the Boy's Head, with the Wound, as it appeared to View, and Part of the Cranium laid bare.

T A B.

T A B. IV.

Represents the Skull, with the Fractures made in it, and the several Splinters, that were taken out.

A... *Is the external Part of the Splinter, adjacent to the superior Part of the Os Malæ, and the upper Part of the Orbit, in its proper Bigness and Figure.*

1. *Is the thick Protuberance of the Basis and inferior Part of the Os Frontis, broke off and separated from the superior Extremity of the Os Malæ in the transverse Suture.*
2. *Is the lower Part of it broke off from the upper Part of the Os Sphenoides.*
3. *Is Part of the Sutura Transversalis.*
4. *Is the Diploc, and its Thickness, being very rugged and irregular.*

B... *Is the internal and concave Parts, with the Thickness of the same Splinter.*

1. *Is Part of the Concavity of the upper Part of the Orbit.*
2. *The superior Part, with its Thickness and Diploc.*
- 6 and 7. *The external and internal Tables.*
3. *The inferior and internal Part separated from the Os Sphenoides: The Middle of it is a deep Concavity.*
4. 4. *A rugged Ridge arising from its Cavity, and likewise from the great and middle one.*
5. *The internal and concave Part.*
8. 8. *Part of the Sutura Transversalis.*

C... *Is Part of the inferior and Basis of the Os Frontis and Bregma, with some of the lower Part of the Sutura Coronalis; being very thin in the Middle where the Suture is, it shews its proper Bigness and Figure.*

1. *The Diploe.*

D.D.D. *Threë other Splinters in their proper Bignesses and Figures.*

1. 1. 1. *The Diploe and both Tables.*

E... *The Splinter that lapt over the Depression, which was sawed off.*

F. *The Stone mentioned in the next Paper.*

VIII. *A Case communicated by Mr. J. Mackernels, Apothecary, in Chipping-Norton, in Oxfordshire, of an extraordinary Stone voided by the Anus.*

MRS. *Mary Smith*, Wife of *John Smith*, of *Chadlington* in the County of *Oxon*, aged about 31, a tall well-shaped strong-made Woman, was seized with a violent Fever, accompanied with great Heat, Restlessness, Pain in the Head, Twitchings of the Tendons, pale Urine, unequal Pulse, Difficulty of breathing, great Costiveness, and without Thirst. She had a hard Labour about Three Weeks before. This Fever seized her the 2d of *January* 1727. and lasted till the 17th, during which Time she was very costive, and continued so till she had another Child, which was the latter End of *February* 1728. and was frequently subject to Attacks
of

of a Fever, notwithstanding she observed a most regular Temperance: Her Labour was always difficult, and she bred her Children very fast: She lay in again in *December* 1728. and in *May* 1731. and the Child she lay in with at this Time had a hollow Dent above the Temples, on the Left Side of the Head, and is now living. She lay in again in *September* 1732. and in *October* 1733. These Two last Labours were the most violent, and the Children had both Dents in the same Place of the Head, the last the biggest, the Hollow being big enough to contain half a small *Orange*; and the Two Children were still-born, but alive till the Moment they came to the Birth. In *December* 1733. she was seized with a Fever, and violent Pains cross her Loyns and Back, great Costiveness, Pain at the Neck of the Bladder, and a Pain and Heaviness about the Region of the *Os Pubis*. I took some Blood from her, gave her soft gentle Purges, with the intermediate Use of balsamic and diuretic oleaginous Mixtures and Apozems; but it was difficult to get any common Dose of purgative Medicines to work with her: I then had recourse to Clysters, but all without any Effect, except that her Fever remitted; but she had no Relief from her Pains, and her Costiveness increased, having no Stool but what was from Purges or Clysters, or both; and the Excrements that came from her were formed in a very odd Figure, like the Leaves of the great *House-leek*, in *Strata*, one on the other; and thus she was for several Months, and then her Urine began to grow fetid, and a slimy Substance fell to the Bottom of the Por: Her Pains still continued; she found no Relief from any Medicines, except
Opiates;

Opiates; and these I was obliged to use but seldom, because of her Costiveness. The Stench of her Urine increased, and now a purulent Matter discharged itself in great Quantity: I concluded she had an Ulcer in the Bladder: Mr. *Wisdom*, a neighbouring Surgeon, passed a Catheter into the Bladder, and he perceived a Swelling just above the Groin, in the Left *Hypochondre*, which was very hard: We advised her to Patience and Resignation, in hopes Nature might point out some Method for her Relief; and gave her no more Medicines, but a soluble Electuary to procure her Stools, which she took every Night. After some Time, the fetid purulent Matter ceased from discharging itself in the Urine, but came away through the *Vagina*, after the manner of the Whites. She was quite emaciated, and grown to a Skeleton, by continual Pain, and those Discharges. In *April* 1735. another Turn happened: That purulent fetid Matter, which discharged itself at the *Vagina*, now came through the *Anus*; she complained of a prodigious Weight there, and about the Middle of *June* 1735. she had frequently very bloody Stools, and once a Discharge of more than half a Pint of fresh Blood. On the 2d of *July*, having Occasion to go to the Close-stool, as she sat there hard straining, but to no Purpose, she thought she felt a hard Substance ready for Expulsion, and sent for her Neighbours, who found a large Substance hard and rugged, (so much, that it tore one of the Womens Fingers, and made it bleed) in the lower Part of the Gut *Rectum*, close to the *Sphincter Ani*. Mr. *Wisdom*, the Surgeon, was immediately called, who endeavoured to
ex-

extract this Substance, and broke some Part of it off, but was forced to dilate the *Rectum*, and so extract it that Way. It was a hard unequal ragged flinty Stone, [see the Figure of it in TAB. IV. at F.] was Ten Inches and an half round, and weighed Eight Ounces and an half, after it was extracted. The Woman has been easy from that Moment; the Wounds, by the Care and Skill of her Chirurgions, are healed; she goes about her Business, has got a good deal of Flesh, and is recovered perfectly, except a Numbness and Contraction she has in some of her Fingers of both Hands, and both Feet and Toes.

J. Mackarness.

IX. *An Account of Mr. Leeuwenhoek's Microscopes; by Mr. Henry Baker, F. R. S.*

HAVING been favoured by this Illustrious SOCIETY with an Opportunity of examining the much-talked-of Microscopes of the famous Mr. *Leeuwenhoek*, who, by his Glasses, made such wonderful Discoveries in the *Minutiae* of Nature, as have laid the Foundation of a Philosophy unknown to preceding Ages; I think it incumbent on me to shew the Use I have been making of them.

Upon opening the Cabinet that contains these Microscopes, I laid before me an Account of them, drawn up, and presented to this SOCIETY, some Years ago, by its present worthy Vice-President
Martin

Martin Folkes, Esq; * and found it such an exact and full Description of their Structure and Uses, as renders any farther Attempt to that Purpose intirely needless. I had likewise the Pleasure to find, that the judicious Observations of this Gentleman, on the Goodness of the Glasses, and the admirable Dexterity of Mr. *Leewenhoek* in the Management and Application of the Objects fitted to them, had reduced my Task to so narrow a Compass, that little more is left for me to offer than a Calculation of their magnifying Powers, some Reflections arising from such Calculations, and a brief Account of what Improvements in Microscopes have lately been made amongst us.

In order to this, the first thing I went about, was to view attentively the Objects applied to these Microscopes by Mr. *Leewenhoek* himself, which Mr. *Folkes* has given a List of in his Account; but the greatest Part of them were, I found, destroyed by Time, or struck off by Accident; which indeed is no Wonder, as they were only gleyed on a Pin's Point, and left quite unguarded. Nine or Ten of them, however, are still remaining; which, after cleaning the Glasses, appeared extremely plain and distinct, and proved the great Skill of Mr. *Leewenhoek*, in adapting his Objects to such Magnifiers as would shew them best, as well as in the Contrivance of the Apertures to his Glasses, which, when the Object was transparent, he made exceeding small, since much Light in that Case would be prejudicial: But, when the Object itself was dark, he enlarged the Aperture, to give it

* *Philosophical Transactions*, N^o 380.

all possible Advantage of the Light.—The Lens being set so as to be brought close to the Eye, is also of great Use, since thereby a larger Part of the Object may be seen at one View.

It must be remembered, that all these Microscopes are of one and the same Structure, and that the most simple possible, being only a single Lens, with a moveable Pin before it, on which to fix the Object, and bring it to the Eye at Pleasure.

Though I was sensible it must cost much Trouble to measure the focal Distances of these 26 Microscopes, and thereby ascertain their Powers of magnifying, I considered that, without so doing, it would be impossible to form a right Judgment of them, or make any reasonable Comparison between them and our own. This Task therefore I have performed, with as much Care and Exactness as I was able; and have shewn, in the following Table, how many of them have the same Focus, and consequently magnify in the same Degree; how many times they magnify the Diameter, and how many times the Superficies of any Objects applied to them. I have given the Calculations in round Numbers, the Fractions making but an inconsiderable Difference; and hope any Mistakes I may have made in so nice a Matter will be excused.

A Table of the Focal Distances of Mr. Leeuwenhoek's 26 Microscopes, calculated by an Inch Scale divided into 100 Parts; with a Computation of their magnifying Powers, to an Eye that sees small Objects at 8 Inches, which is the common Standard.

Micro- scopes with the same Focus.	Distance of the Focus.	Power of mag- nifying the Dia- meter of an Object.	Power of mag- nifying the Superficies.
	<i>Parts of an Inch.</i>	<i>Times.</i>	<i>Times.</i>
* I.	$\frac{1}{20}$ or $\frac{5}{100}$	160	25600.
I.	$\frac{6}{100}$	133 nearly.	17689.
I.	$\frac{7}{100}$	114 nearly.	12996.
3.	$\frac{8}{100}$	100.	10000.
3.	$\frac{9}{100}$	89 almost.	7921 almost.
8.	$\frac{1}{10}$	80.	6400.
2.	$\frac{11}{100}$	72 something more.	5184 something more.
3.	$\frac{12}{100}$	66 nearly.	4356 nearly.
2.	$\frac{14}{100}$	57	3249.
I.	$\frac{15}{100}$	53 nearly.	2809 nearly.
I.	$\frac{1}{5}$	40.	1600.
<u>26.</u>			

* This largest Magnifier of all is in the Box marked 25.

It appears, by the foregoing Table, that One only of these 26 Microscopes is able to magnify the Diameter of an Object 160, and its Superficies 25600 times; all the rest falling much short of that Degree. And therefore, I am fully persuaded, and believe I shall be able to prove, that many of the Discoveries Mr. *Leeuwenhoek* gives an Account of, could not possibly be made by Glasses that magnify no more than this.

I beg Leave to observe, that our Cabinet is but the Second in Mr. *Leeuwenhoek's* Collection, and is very far from containing all the Microscopes he had, as many wrongly have imagined. We find here indeed, 26 Microscopes in 13 little Boxes: Each Box contains a Couple of them, and is marked in Two Places with a Number, to distinguish it from the rest. But as the first of these Boxes is marked 15, and the rest with following Numbers on to 27; it necessarily implies there were 14 preceding Boxes, since no Man begins with the Number 15.—Mr. *Leeuwenhoek*, then, had another Cabinet, that held 14 Boxes before ours in numerical Order, and probably each Box contained a Couple of Microscopes, as our Boxes do. But, besides these Two Cabinets, he had several other Microscopes of different Sorts, as his own Writings will make appear.

The Cabinet now before us seems to have been only his Repository of Objects; for every Microscope herein was engaged by an Object affixed to it, and thereby rendered useless for any other Purpose; whereas those he employed in his daily Observations must have been always ready, and at full Liberty, to examine whatever offered. Many of them too,

must certainly have been much greater Magnifiers than any in our Possession.—And we are assured by himself, that such he had ; for he often mentions his shifting Objects from his common to his better, and thence to his most exquisite Microscopes: And, besides, (in the Second Volume of his Works, Part Ild. pag. 290.) he says, “ *Mihi quidem sunt centum* “ *centumque Microscopia, &c.* “ I have an hundred “ and an hundred Microscopes, most whereof are “ able to shew Objects so distinctly, even in the “ cloudiest Weather, and by Day-light only, that if “ the *Animalcula in Semine masculino* of Animals “ had the Extremity of their Tails forked, (as described by a certain Writer) I should easily have “ discovered it.”—Among this Number, many, without doubt, were contrived for the Examination of Fluids, since great Part of his Observations were made on them: He informs us also, that his Method was to put them into an exceeding small or capillary Tube of Glass, which there does not seem to be any Means of applying to the Microscopes in our Cabinet, even had they been at Liberty ; and much less for the larger Tubes he made use of to view the Circulation of the Blood in *Frogs, Eels, Fishes, &c.* his Apparatus for which we find in the Fourth Volume of his Works, pag. 180.—But to proceed:

Mr. *Leeuwenhoek*, in a Letter to this SOCIETY concerning the *Animalcula* observed by him in the *Semen masculinum* of a *Dog*, which he describes and gives a Draught of, says, they were so minute, that he believed a Million of them would not equal the Size of One large Grain of Sand, Vol. I. Part I, pag. 169. Again, in his 113th Letter, speaking of the
Semen

Semen virile, he declares, that a Million of the *Animalcula* seen therein would not equal a large Grain of Sand; and yet he gives a full Description of their Form; for he says, their Bodies are roundish, somewhat flat before, but ending sharp behind, with Tails exceedingly transparent, Five or Six times longer, and about Five times slenderer, than their Bodies; so that their Figure cannot better be represented, than by a small *Earth-nut* with a long Root or Tail.

Now the Focus of the greatest Magnifier of his being $\frac{1}{40}$ of an Inch, as near as can well be measured, it is capable of magnifying the Diameter of an Object (to an Eye that sees small Objects best at Eight Inches) no more than 160, and the Superficies 25600 times: So that Objects, One Million whereof scarce equal a Grain of Sand, viewed through such a Lens, (as only the Superficies can be seen) could appear no larger than Two Grains and half of Sand would be to the naked Eye; and I submit it to be considered, whether that is not too small a Size for any Man to describe so particularly, and delineate the Form and Parts of.

But Mr. *Leeuwenhoek* goes yet abundantly farther: For, to mention only one Instance, of which there are several in his Writings; he tells this SOCIETY in his Letter of *July 25. 1684.* that he could discern Vessels in the human Eye, so amazingly minute, that, desiring to know their Smallness, he measured them by the Diameter of a Grain of Sand, (the Process of which Mensuration is there set down) and found by arithmetical Calculation, that a large Grain of Sand
must

must be divided into * Eighteen thousand Three hundred Ninety-nine Millions Seven hundred Forty-four thousand Parts, ere it can be small enough to enter these minute Vessels.—What shall we now say?—Why, in regard to the Memory of this great Man, to whom the World, and this SOCIETY, are much obliged, I must insist, that he certainly had Glasses, that were much greater Magnifiers than any we have of his.

It may perhaps be objected, that Mr. *Leeuwenhoek* declares, he did not use such small Glasses as some People boasted of; and that, although for 40 Years together he had been possessed of Glasses exceedingly minute, he had employed them very seldom; since, in his Opinion, they could not so well serve to make the first Discoveries of Things, as those of a larger Diameter. In Answer to this, I must beg Leave to observe, that Mr. *Leeuwenhoek*, in this Place, is reflecting on a certain Physician, who boasted of an extraordinary † Microscope scarce bigger than a visible Point, whereby he pretended to discover the *Animalcules in Semine virili* to be exactly of an human Shape, with only a Skin over it. For he says, that while he was attentively observing these *Animalcules*, one of them (a little bigger than the rest) presented itself, having almost slipped off its Skin: And then there plainly appeared Two naked Thighs and Legs, a Breast, and Two Arms, above which, the Skin being thrust up, covered the Head as it were a Cap.

* Vol. I. p. 39.

† Epist. 116. Vol. II. Part II. pag. 84.

The Sex he confesses he could not distinguish, and adds, that it died in endeavouring to get clear of the Skin.

Mr. *Leeuwenhoek* very justly exposes this romantic Discovery, pretended to be made by this Speck of a Microscope; and takes occasion therefrom to let us know, he does not think such minute Glasses are so much to be depended on as those of a larger Diameter. But there are so many Degrees between the smallest Glass we have of his, (whose Focus is at $\frac{1}{10}$ of an Inch) and this almost invisible Point, that we must not infer from hence he used none of a Size between. Nay, this very Letter seems to imply the contrary; for it tells us, that, in examining the *Semen virile*, he made use of Eight or Ten Microscopes of different magnifying Powers: But as all the Microscopes we have of his, have Objects fastened to them, and besides have no Apparatus for Fluids, I think they could not probably be the same he employed for that Examination. May we not rather suppose he had Eight or Ten different Sizes of Microscopes, that magnified more than ours? For we know, Fluids require to be examined by the greatest Magnifiers; and doubtless he made use of such for that Purpose.

There is no Advantage in employing a greater Magnifier for any Object, than what is requisite to shew the same distinctly; but when the Object is exceedingly minute, the magnifying Power of the Glass must be proportionably great, or else it will be impossible to see the Object clearly. A Lens, (for Example) that shews a whole *Flea* distinctly, magnifies

nifies not near enough to shew the *Animalcules* in the *Semen* of that *Flea*.

I am sensible, that Mr. *Leeuwenhoek*, by long Practice, and uncommon Attention, might be able to discern many Objects with these Microscopes, which others, less accustomed to Observations of this kind, cannot readily do: His Eyes too might be somewhat different from the Standard I measure by. But all these Allowances will not, I think, suffice to reconcile the Passages I have quoted with the Powers of the Glasses under Examination.

While I was overlooking these Microscopes of Mr. *Leeuwenhoek*, an Opportunity presented of examining and comparing with them a curious Apparatus of Silver with Six different Magnifiers, belonging to Mr. *Folkes*, and then newly made for him by Mr. *Cuff*, in *Fleetstreet*.—The Body of this Instrument, into which the Glasses are occasionally to be fastened, is after the Fashion of *Wilson's* Pocket Microscope, and contrived to screw into the Side of a Scroll fixed on a Pedestal, from which a turning *Speculum* reflects the Light upwards upon the Object: It is likewise contrived to be used with the Apparatus of the Solar Microscope: Descriptions and Figures of both of which I have since given in a Book intituled, *The Microscope made easy*. Edit. 2^d. *Lond.* 1743. 8^o.

I measured the focal Distances, and magnifying Powers, of the Six Glasses, and found them to be as follows:

A Table of the Six Magnifiers belonging to Mr. Folkes's Microscope, calculated by an Inch Scale divided into an hundred Parts, with a Computation of their Powers, to an Eye that sees Objects at Eight Inches.

Glas-	Distance of	Magnifies the	Magnifies the
ses.	the Focus.	Diameter.	Superficies.
1ft. . .	$\frac{1}{8}$ of an Inch. . .	400. . .	160,000.
2d. . .	$\frac{1}{10}$	160. . .	25,600.
3d. . .	$\frac{8}{100}$	100. . .	10,000.
4th. . .	$\frac{18}{100}$	44. . .	1,936.
5th. . .	$\frac{3}{10}$	26. . . .	676.
6th. . .	$\frac{1}{2}$	16. . . .	256.

The above Calculation shews, that Mr. *Folkes's* First Glasß magnifies the Superficies of an Object Six times as much as the greatest Magnifier of Mr. *Leeuwenhoek*: And that the *Animalcula* (a Million whereof, he says, scarce equalled the Bigness of a Grain of Sand) would, if viewed with this Magnifier, appear as large as Sixteen Grains of Sand do to the naked Eye. And I cannot suppose but Mr. *Leeuwenhoek* had Glasses to magnify even more than this, though they are not come to us. For I cannot otherwise conceive, how he could observe the *Animalcules* in the *Semen masculinum* of a *Flea*, and of a *Gnat*, as we find he did, (Vol. IV. pag. 21, 22.) or assert, as he does in the strongest Terms, (pag. 23.) that he could see the minutest Sort of *Animalcules* in *Pep-per-water*, with his Glasses, as plainly as he could Swarms of *Flies*, or *Gnats* hovering in the Air with

his naked Eye, though they were more than Ten Millions of Times less than a Grain of Sand.—And lest this should be imagined only a random Guess, he gives immediately a regular Arithmetical Calculation to prove his Computation right. But I believe we must all be sensible, that no Glasses in this Cabinet are able to render such minute Objects distinguishable.

I am desirous to do all possible Justice to these Microscopes, by acknowledging their Excellence, as far as their magnifying Power extends: But I should do Wrong to Mr. *Leewenhoek*, should I suffer the World to believe these were his greatest Magnifiers; since whoever hereafter should examine them with that Imagination, would be apt to entertain a bad Opinion of his Veracity.

Experience teaches, that Globules of Glass extremely minute, though they magnify prodigiously, are seldom able to shew Objects sufficiently distinct, and therefore are very apt to lead People into Errors: Which certainly was a good Reason for Mr. *Leewenhoek's* rejecting them: But a ground convex *Lens*, though much smaller than any of his before us, if rightly applied, will shew exceedingly minute Objects magnified to a surprising Degree, and with sufficient Light and Clearness, as Mr. *Folkes's* First Glass witnesses.

I hope I shall not be imagined to intend any Disrespect to this famous Man, if I suppose, that our present Microscopes are much more useful and convenient than these of his. Let him always be remembered with the highest Honour, for the wonderful Discoveries he made, and the Microscopes he

has left us, which are indeed extraordinary, when considered as the First almost of their Kind: Let us reverence him as our great Master in this Art. But the World since must have been strangely stupid, if it could have improved nothing, where there was room for so much Improvement. I do not mean as to the Glasses (for the Goodness of these before us, gives just Reason to believe he might have others as excellent as can perhaps be ever made); but as to the Structure of the Instrument they are set in, and the Manner of applying Objects to them. And I fancy most People will allow, that herein great Improvements have been made: And it is with Pleasure I find, that a large Share of the Credit belongs to our own Countrymen.

One thing alone (which, when slightly considered, may appear but trifling) has conduced greatly to these Improvements; and that 's, the making use of fine transparent *Muscovy Talc* or *Isinglass*, placed in Sliders, to inclose Objects in. Had Mr. *Leeuwenhoek* known this Way, it would have saved him a vast deal of Expence and Trouble: For then, we may reasonably suppose, instead of making an intire and separate Microscope for every Object he was desirous to keep by him in Readiness to shew his Friends, he would probably have secured his Objects in Sliders, as we at present do, and have contrived some such Means as ours, of screwing his several Glasses of different magnifying Powers, occasionally, to one and the same Instrument, and of applying his Sliders to which of them he judged best.—A few good Glasses, gradually magnifying one more than other, would, by such a Method, have answered all the

Purposes of his great Number, and his Objects would have been preserved in a much better Manner.

I shall forbear troubling you with the different Microscopes invented by *Wilson*, *Marshall*, *Culpeper*, *Scarlet*, and others, (though all deserving Praise) since you are already so well acquainted with them: But Two extraordinary Improvements have appeared within these Two Years, which I beg Leave to lay before you, as I think it has not been yet done.— I mean, the Solar or *Camera Obscura* Microscope, and the Microscope for opaque Objects. Both these Inventions we are obliged for to the ingenious Dr. *Liberkhun*, who, when he was in *England* last Winter was Twelvemonth, shewed an Apparatus of his own making, for each of these Purposes, to several Gentlemen of this SOCIETY, as well as to some Opticians, amongst whom Mr. *Cuff*, in *Fleetstreet*, has taken great Pains to improve and bring them to Perfection; and therefore the Apparatus prepared by him is what I am about to describe.

This Solar Microscope is composed of a Tube, a Looking-glass, a convex Lens, and a Microscope. The Tube is of Brass, near Two Inches in Diameter, fixed in a circular Collar of *Mahogany*, which, turning round at Pleasure, in a square Frame, may be adjusted easily to a Hole in the Shutter of a Window, in such a Manner, that no Light can pass into the Room but through the aforesaid Tube. Fastened to the Frame by Hinges, on the Side that goes without the Window, is a Looking-glass, which, by means of a jointed brass Wire coming through the Frame, may be moved either vertically or horizontally, to throw the Sun's Rays through the brass Tube into the darkened Room.

Room. The End of the brass Tube without the Shutter has a convex Lens, to collect the Rays, and bring them to a Focus; and on the End within the Room, *Wilson's* Pocket-Microscope is screwed, with the Object to be examined applied to it in a Slider. The Sun's Rays being directed by the Looking-glass through the Tube upon the Object, the Image or Picture of the Object is thrown distinctly and beautifully upon a Screen of white Paper, and may be magnified beyond the Imagination of those who have not seen it. —I assisted lately in making some Experiments with Dr. *Alexander Stuart*, by means of this Instrument, and a particular Apparatus contrived, by him, for viewing the Circulation of the Blood in *Frogs, Mice, &c.* and had the Pleasure of beholding the Veins and Arteries in the Mesentery of a *Frog* magnified to near Two Inches Diameter, with the Globules of the Blood rolling through them as large almost as *Pepper-corns*. We examined also the Structure of the Muscles of the *Abdomen*, which were prodigiously magnified; and exhibited a most delightful Picture. But, as the Doctor intends himself to communicate to you an Account of these Experiments, I will not anticipate your Pleasure.

The Microscope for opaque Objects remedies the Inconvenience of having the dark Side of an Object next the Eye: For by means of a concave Speculum of Silver, highly polished, in whose Centre a magnifying Lens is placed, the Object is so strongly illuminated, that it may be examined with all imaginable Ease and Pleasure.—A convenient Apparatus of this kind, with Four different Specula, and Magnifiers of different Powers, has lately been brought

to Perfection by Mr. *Cuff*; whose Copper-plate and Description of it, as it will save much Trouble, and make me better understood, I take the Liberty, at his Desire, to present herewith, together with his printed Account of the Solar Microscope, the Pocket Microscope, and the Microscope before spoken of, with a Scroll, Pedestal, and Speculum, of which there are also Copper Plates. These, with the large double reflecting Microscope, are, I think, the chief, if not the only useful Sorts now made in *England*.

I must not omit taking notice, that Mr. *Leewwenhoek* says, (in his Second Volume, Part II. pag. 93.) that sometimes, to throw a greater Light upon his Objects, he used a small convex Metal Speculum. How he applied it, I will not pretend to guess; but it is highly probable our double reflecting Microscope may be owing to this Hint. I must also observe farther, that in the Fourth Volume of his Works, pag. 182. after describing his Apparatus for viewing *Eels* in glass Tubes, Mr. *Leewwenhoek* adds, that he had another Instrument, whereto he screwed a Microscope set in Brass; upon which Microscope, he tells us, he fastened a little Dish (of Brass also, I suppose), that his Eye might be thereby assisted to see Objects better: For he says, he had filed the Brass which was round his Microscope, as bright as he could, that the Light, while he was viewing Objects, might be reflected from it as much as possible. This Microscope, with its Dish, (which I give an exact Copy of from the Picture in his Works) seems so like our opaque Microscope with its silver Speculum, that, after considering his own Words, I submit to your better Judgment, whether he is not properly
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the Inventor of it. His Words are these,—“ Supra
 “ hoc Microscopium Catillum ferruminavi, ut oculus
 “ objecta tanto melius videret: nam cuprum circa
 “ Microscopium, quantum pote, lima abraferam, ut
 “ Lumen in conspicienda objecta, quantum pote,
 “ irradiaret.”

See the Figure of this Apparatus in TAB. IV. at G.

X. *An Inquiry into the Causes of a dry and wet Summer. By an anonymous Hand.*

THE wet Weather which we had in *March* 1734. (the Year beginning with *January*) set me on considering what might be the Causes of it. The Wind was then, generally, South-west, the Weather rainy. Sometimes it veered to South-east, which, commonly, brought much Rain: But the Wind seldom stood at that Point 24 Hours, before it returned to South-west again. A strong Gale at South-west, with Rain; would be succeeded by as strong at North-west, still raining; but if the North-west continued 24 Hours, it cleared the Sky. The Summer following was cold and wet; the Wind on the same Points. The preceding Winter was mild, and especially *December*, in which Month, from the 10th inclusive, the Wind blew, generally, South-west, sometimes strong, attended with much Rain. At the End of *December*, the Birds sang, and the Grass did grow as at other Years in the Spring.

The Winter of 1734. was as mild as that of 1733. the Birds as joyful, and the Grass as green at the End
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of *December*, the same Winds still prevailing; but the South-west was more stormy. On *December* 29th, there blew a Storm, first from South-west, and then from North-west: But the Storm of *January* the 8th was much stronger, which blew on the same Points. The Summer of 1735. was colder, and wetter than the preceding Summer.

This put me on recollecting what sort of Winter went before a dry Summer. In the Year 1731. the Summer was remarkably dry. I had not begun to keep a Journal of the Weather in the Year 1730. But I took so much Notice of the unusual Cold in *April* 1731. that I made the following Remarks. *April* 1. begins with peircing cold Winds at North-east, black Clouds, stormy, very dry. 4th, 5th, some Wind, Ice. 6th, 7th, 8th, 9th, same Wind. 9th, Snow. 10th, The Harbour frozen over. If my Memory doth not fail me very much, it was in the Winter of the Year 1730. or the Beginning of 1731. that a *Horse* was frozen to Death in *Moscow*, as he stood in the Street.

From hence I conclude, that a frosty Winter produces a dry Summer; and a mild Winter a wet Summer. I am sensible, that these Conclusions are drawn from short and imperfect Observations: But, supposing them to be true, I would be glad to know why these things are so.

I find from these and some other Observations, which I have casually made, that the Weather depends very much on the Wind. I shall therefore begin with inquiring what is the Cause of Winds, and then proceed to find out, as well as I can, why the Wind doth influence the Weather.

Wind

Wind is a Stream of Air; Air an unmixed Fluid encompassing our Globe, with a Shell of at least 60 Miles thick. Every Particle of Air gravitates equally towards the Centre of the Earth. Air is capable of being compressed and expanded: The more Air is compressed, the heavier it is; the more it is expanded, the lighter. Cold and Heat, whatever they be, or however they act, produce these contrary Effects in the Air: That is, Cold doth compress the Air, and Heat expands it: Therefore Cold and Heat, in different Parts of the Air, will make it flow: For Cold making the Air heavy, and Heat making it light, the lighter must, of course, give Way to the heavier; as, in a Balance, a greater Weight makes a smaller rise. We daily see a Proof of this in a Stove.

The Sea and Land-breezes, and the Trade-wind, owe their Original to the'se Causes. The Sea-breeze, when regular, begins at Nine o'Clock in the Morning, approaches the Shore gently, at first; increases till Twelve; retains its full Strength till Three; then gradually decreases till Five, when it dies away. At Six in the Evening the Land-breeze begins, and continues till Eight next Morning: The Interval between these Two Breezes, at Morning and Evening, are the hottest Parts of the Day. It is said, that these Winds vary in their Periods; which not being to my Purpose, I take no Notice of.

The way of accounting for this Vicissitude of Sea and Land-wind, is thus: The Sun, as it ascends, sheds its Heat equally on the Land and Sea; but the Earth receives the Heat sooner than the Water, or else reflects it stronger. For one or both of these Reasons, the Air that hangs over the Land, is heated more

than the Sea-air, it becomes thereby more rarefied, and consequently lighter; and therefore the Sea-air, with its superior Weight, flows in upon it every Way. The Intervals between are owing to the Air of both Places being in an equal Degree of Heat, and consequently of equal Weight.

The Trade-wind never varies, which is thus accounted for: The Air just under the Sun is the hottest: The cold Air presseth upon the hot, as the hot Air follows the Sun; and therefore it makes a perpetual Flow of Wind between the Tropics from *Africa* to *America*, and from thence to the *East-Indies*.

With regard to the Wind influencing the Weather; I find that though Air be an unmixed Fluid, yet it is capable of receiving many Vapours, which float in it, as we see other Bodies float in Water. Sometimes the Vapour ascends, and sometimes it falls to the Ground. All which I take to be effected by Heat and Cold in this Manner: Heat separates Water into small Particles, and the incorporated Air, rarefied by the same Heat, blows up those Particles into Bubbles; by which means the swoln Vapour becoming specifically lighter than a like Space of ambient Air, ascends, swift, at first, (which affords a pleasant Sight in a warm Summer's Day) and then gradually flower, till it gets up to that Part of the Air which is of equal Lightness with itself; and there it remains, as long as the Air continues in the same State: But whenever the Air cools, in which these watery Bladders float, the Cold contracts the Bladder, which becoming thereby specifically heavier than the Air, down it falls in Dew, or Rain. A common
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Alembic sufficiently shews the Operation of Heat and Cold on the ascending and descending Vapour.

Thus in a calm Evening, when there is no Wind to waft the Air, as the Heat of the Sun declines, the Cold arrests some few of the last ascending Vapours, and, by its own Force, without any other Change in the State of the Air, compels them to return, in Dew, to the very Spot from whence they arose; whilst their Brethren escape, who go out of the Reach of the Cold a little before the Approach of Night.

Since therefore the same Air, in different States of Heat and Cold, affects Vapour in this Manner, it thence follows, that Vapour, wafted from Air of one Temperament to another, must be affected in the same Manner also: So that Vapour, carried from a colder to a warmer Air, will ascend; and, on the contrary, Vapour carried from a warmer to a colder Air, will descend.

Now if Cold condenses the Air, and thereby makes it press upon the warmer; and if Vapour, carried by a Stream of Air from a colder to a warmer Region, ascends; we have the Reason why the North-east blows, and why it blows dry.

Let us fix upon some Spot in the Continent of *North-Europe*, whence this Wind comes to us: Suppose *Archangel*, which lies on our North-east Point, and is in 65 Degrees Northern Latitude: When the Frost is intense, the incumbent Air there must needs be very heavy; that Air will press every Way: *Quà data porta, ruit*. Let us consider which Way this condensed Air can burst out from thence: It cannot go to the North, where the Cold is greater;

nor to the East, for the Air over the large Continent of *Tartary* is at least of equal Coldness with itself. I make no doubt but they complain at *Archangel*, in their Turn, of cold North and North-east, and even East Winds, as much as we do here. The great Continent to their South must be so cold as to make a strong Resistance: To the West, the Air might find a free Passage over the Ocean, were not the Colds of *North-America* too near. The main Outlet is between both, towards the *Atlantic Ocean*: The warm Air over which being able, of itself, to make but a feeble Resistance, yields to the superior Force; the Conqueror eagerly pursues his Victory, and we, happening to lie directly in the Way, feel then a cold dry North-east Wind: This is the Wind that brings us Frost in the Winter. When the Winter is severe, it continues to blow all the Spring, and its Influence reaches to the End of the Summer.

This, I think, sufficiently proves, that Air, flowing from a cold to a warmer Quarter, will blow dry: But, like a willing Witness, it proves too much; for, if Wind proceeds only from cold Air pressing upon hot, and if Heat makes the Vapour ascend, it follows from thence, that Wind can never bring Rain; whereas we find the contrary by sad Experience; the South-west Wind hath ruled these Two Years, and still doth rule.

How can this be accounted for, upon the Principles commonly received? That Vapour, waisted from a warmer to a colder Region of Air, should precipitate, is what I have already shewn. But the Question is, which I have not as yet seen answered, Why does the South-west blow? What is the Cause why a Stream
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of Air should be carried, for so long a Time, and with so great Violence, as we have often felt, from a warmer to a colder, from a rarer to a denser, from a lighter to a heavier Quarter? To the North-east of us lies the Continent of *North-Europe*, great Part of which is, in the Winter, deprived of the Sun's Heat, and consequently very cold; on the other Side, to the South-west, lies the vast *Atlantic Ocean*. We find by Experience, that the Sea-shore is warmer than the Inland; that the Sea is warmer than the Shore; and that the Ocean is still warmer than the Sea. Besides, the more you go from hence towards the South, the nearer you go to the Sun; and the more North, the farther from it: This must make the South-western Ocean much warmer than the Continent, that lies at an equal Distance, on the opposite Point: From this very warm Place, the Wind blows to a Place much colder; and yet there must be a natural Cause of all this apparent Contradiction to the Laws of Nature: Whether we can find it out or not, I shall attempt it as well as I can.

It will be in vain to seek for the Cause of this Wind in this Ocean itself, or in the Air over it, influenced only by the Sun, and the Surface of the Sea. But there may be *Tornados* in those Seas: Our Seamen often meet them between the Tropics, seldom, as I am told, in the Ocean I am now speaking of, which is to the North of the Northern Tropic. But were they more frequent and violent than they really are, yet they are not lasting, and therefore cannot produce a long steady Course of South-west Winds with us.

My Conjecture is, that our South-west Wind is no other than an Eddy of the Trade-wind, reflected from *America* to us. Though we cannot see the Eddy of Air, as we do that of Water; yet we must be otherwise very sensible, that it makes a strong Recoil, when it meets with lofty Buildings, Woods, Hills, &c. The more elastic any Body is, it rebounds with the more Agility; and the Experiments that have frequently been made, sufficiently shew the vast Elasticity of the Air. There can, I think, be no Difficulty in conceiving, that there may be an Eddy of Wind from that Part of *America* which lies under the Equinoctial Line, even to us, provided there be a sufficient impelling Force, and due Resistance, and a proper Direction.

The impelling Force is a steady brisk Stream of Air, flowing perpetually from *Africa* to *America*: The Strength of this Wind may be in some measure judged of, from what Sailors observe, and express in their Language, thus: It commonly blows a good Top-sail Gale, as we sail large; and if we were to sail on a Wind, our lower Sails would be enough. I am sensible of what every Map shews us now, that the Trade-wind does not blow exactly from East to West: But though the Arrows are placed as if shot obliquely towards the Equinoctial, or rather towards a Line parallel to it, and distant from it between 4 and 12 Degrees North Latitude, yet they are all pointed Westward; and that, I presume, will be as much to the Purpose I am upon, as if the whole Stream went due West.

In order to guess at the Momentum of this repelling Force, we should consider the Breadth and
Height

Height of that Part of the Trade-wind, which I suppose to be turned this Way.

With regard to the Breadth, I read in *Dampier*, that they meet the Trade-wind at about 30 Degrees on this Side the Line; as many Degrees on the other Side will make the Whole extend to 60 Degrees broad. Methinks I do not want such a Breadth, nor indeed can I fairly expect it. For so much of this Wind as blows to the South of the most Eastern Point of *South America*, which, I think, is called *Cape St. Augustin*, should turn off Southward; the rest, which blows to the North of that *Cape*, I may lay Claim to. This *Cape* is in about 8 Degrees South Latitude, so that I may demand a Breadth of 38 Degrees; but I will make an Abatement: For though the Trade-wind, to the North of the Line, be sometimes 30 Degrees broad, yet sometimes it is not above 24 Degrees; which Variation depends, as I suppose, on the Sun's Place in the *Zodiac*: So that it is narrowest in the Winter, and widest in the Summer. Taking it then at the narrowest, when the Sun is in the Winter Solstice, we shall have a Breadth of 32 Degrees: But I allow 2 Degrees, to make Amends for the slack Wind, to the North of the Tropic of *Cancer*, and for the Calms near the Equator; and insist on 30 Degrees only, for the Breadth of that Trade-wind, which is to be reflected back to us.

How high soever that Column of Air be, which is carried through this wide Space, no more of it can affect us, than what is repelled by the Hills it strikes against, and by the cold Air which hangs over them.

I take these high Lands, and their incumbent Air, to be a Resistance sufficient to repel the Trade-wind:
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The Land must needs be so to its Height; and the Air over it, being many Degrees colder than the Trade-wind, will make a Resistance in proportion to its superior Weight. How high this Resistance may be, I cannot pretend to determine: If I require no more than 3 Miles from the Surface of the Sea to the Top of the highest Ridge of Hills, within the Tract I am now speaking of, and to the cold Air above them, I think I make but a modest Demand. Here, then, we have a Gale of Wind of the Breadth of 30 Degrees, 3 Miles high, carried with a great Velocity from *Africa* to *America*, a Momentum more than sufficient to drive the Air from *America* to us, if there be but a proper Direction.

Were the whole Stream of the Trade-wind like a Mathematical Line, mere Length, without Breadth, and were this strait Line to strike on a smooth Surface of a given Inclination, we could know its Direction exactly. For it is a Rule in Geometry, that the Angle of Reflexion is equal to the Angle of Incidence. Suppose, for Example, that the Line of Trade-wind blew just South-east, as it is said to do, South of the Equator; that the Surface it struck against ran exactly from South to North, as the Hills of *Peru* do; and that the Point of Incidence were under the Equator; in this Case the Angle of Incidence will be half a Right Angle, or an Angle of 45 Degrees, and consequently the Angle of Reflexion will be 45 Degrees: Now, as these Degrees, when the reflected Line shall have run 90 Degrees in Length, will be equal to Degrees of a great Circle, and as we are about 90 Degrees East of this supposed Place of Contact, therefore this reflected Line will,

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in our Longitude, reach to 45 Degrees of North Latitude, which is about *Bordeaux*. If we should suppose the whole Breadth of the Trade-wind to consist of an infinite Number of parallel Lines, falling on a Surface of the same Inclination, then the reflected Lines will be all parallel, and consequently the Angles will be all equal ; but they will reach wider, according to the Distance of one Point of Contact from the other ; so that if that Line, which fell on the supposed Surface under the Equator, be reflected to 45 Degrees North Latitude, that which fell on the same Surface to the North of the Equator, suppose in 23 Degrees Latitude, will reach to 68 Degrees North Latitude, which is to the Northward of the *Orcades*, and almost to the North Cape of *Norway*. Or if we suppose the Trade-wind to the North of the Equator, to flow directly North-east, as it is also said to do, and to strike against a Surface inclining from South-east to North-west, which is pretty near the Bearing of the *Isthmus* that joins *North* and *South America* ; in both these Cases the Reflexion will be towards the North-east.

But there is no depending on this way of calculating : Not that God does not act according to the exactest Rules of Geometry, in the Motion of the Winds, as well as in all other Parts of the Creation : But we do not know, at least I am far from pretending to know, all the infinite Variety of Reverberations that the Wind must have, from the uneven Surfaces it strikes against, between Cape *St. Augustin* and the Bottom of the Gulph of *Mexico*. I make no doubt but that different Parts of this Air are reflected a Thousand different Ways ; and yet that the

Whole afterwards unite, or the far greater Part, and flow this Way. I find myself under a Necessity of supposing what I cannot demonstrate Mathematically, since I can assign no other Cause why the South-west Wind blows so long with us.

But there are some other Facts which strongly support my Hypothesis; *viz.* Currents of the Sea, and the Wind in the *Atlantic* Ocean, to the Northward of the Trade-wind.

With regard to the Currents, *Dampier* tells us, it is generally observed by Seamen, that, in all Places where the Trade-wind blows, the Current moves the same Way with the Wind; and that though it be perceived most near the Shore, yet it makes no sensible Rising in the Water, as the Tides do. He says, there is always a strong Current setting from Cape *St. Augustin* Westward, occasioned, as he remarks, by the South-east Trade-wind driving the Surface flanting on the Coast of *Brasil*; which, being there stopped by the Land, bends its Course Northerly, towards Cape *St. Augustin*; and, after it has doubled that Promontory, it falls away towards the *West-Indies*, down along the Coast Westward, till it comes to Cape *Gratia de Dios*; from thence North-west towards Cape *Catoch* in *Yucatan*, thence to the Northward between *Yucatan* and *Cuba*. He says, that in the Chancel, between *Yucatan* and *Cuba*, he has found the Currents extraordinary strong; that it is probable, that the Current which sets to Leeward, on all the Coast from Cape *St. Augustin* to Cape *Catoch*, never enters the Bay of *Mexico*, but bends still to the Northward, till it is checked by the *Florida* Shore; and then wheels about to the East,

till

till it comes near the Gulph's Mouth, and pass'es with great Strength through the Gulph of *Florida*, which is the most remarkable Gulph in the World for its Currents, because it always sets very strong to the North.

Thus far this Pilot: And, if too great a Fondness for my own Conjecture does not prejudice me very much, I may venture to say, that these Observations strongly confirm it. He takes notice of the first Current which the Trade-wind makes near the Shore at Cape *St. Augustin*, where it is strong; thence he traces it from one Cape to another, as it winds about by different Directions, yet still gathering Strength at every Turning: It is extraordinary strong between *Yucatan* and *Cuba*, but strongest at the End of its Course in the Gulph of *Florida*. This Acquisition of Strength upon a new Direction, is contrary to the Laws of Motion; therefore it must be owing to a fresh Supply, which the rest of the Current, caused by the Trade-wind, gives it, till at length the whole Power, joined together, rushes out into the *Atlantic* Ocean.

Let us then suppose the Wind, which drives this Water before it, to follow it much in the same Course; and that, instead of striking against one plain Surface, with such an Inclination as would direct it to us, it strikes against a Million, yet still bending this Way: Let this natural Supposition be admitted, and we have the very Thing sought for, *viz.* a proper Direction.

The other Fact is this: That when our Ships return from the *West-Indies* through the Gulph of *Florida*, and are got into the wide Ocean, they have a regular

Wind at South west, or near that Point, which sometimes attends them to their very Port. This Wind cannot have its Rise in that Ocean, nor can it come from any Continent that lies to the North, or even West of it; therefore I conclude, that it must be an Eddy of the Trade-wind.

But to all this it may be objected, that the Sea-current sets out of the Gulph of *Florida* towards the North; whereas, I say, the Wind comes towards the North-east. Sailors, it seems, take no farther Notice of these Currents, than while they are near Headlands, where they are strongest, and affect their Navigation most. But there seems to me to be a Necessity of the Continuance of this Current much farther than the Gulph of *Florida*, and of its taking new Directions from the North towards the North-east, and thence even towards the South, before it be quite spent. For it must be a vast Quantity of Water that is driven by the whole Breadth of the Trade-wind, from *Africa* to the Shores of *America*; the far greater Part of which, as *Dampier* supposes, doth flow by the Promontory of *Cape St. Augustin* Westward. This great Flux of Water has found a Passage out towards the North, between *Florida* and *Cuba*; which is the Reason, that, notwithstanding the Current sets Westward, the Sea in the *West-Indies* never rises. Here we see, that the Middle Ocean is at a great and constant Expence of Water; it must therefore want a Supply, and no Supply so natural, as for it to have its own Water again; which, after it hath passed the Gulph of *Florida*, meets with one Check still after another, till it returns to the Place from whence it came.

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For the same Reason we may suppose, that though the Eddy of the Trade-wind should be reflected due North, from the Land it first strikes against; or even though it should undergo as many Turnings as the Surface of the Sea it drives before it; yet it may take a new Direction in the Ocean, caused by the Winds that blow from the Continent of *North America*.

Another Objection may be made against the South-west Wind being an Eddy of the Trade-wind, from what I myself have advanced, *viz.* that Cold is the Cause of Wind: That the *Atlantic* Ocean is too warm to produce this Wind; and yet that it comes from the Trade-wind, which blows between the Tropics, a Place much warmer: So that, according to this, here is a very warm Wind making its Way against the Cold of the North.

That Wind will blow from a warmer to a colder Quarter, is confirmed not only from the South-west raging with us in Winter, which must be confessed to come from a much warmer Climate, whatever Cause it be owing to; but from the almost daily Observation of those who live in the Country, and will look a little about them. Whoever is within the Sight of Hills, and there are few Places where there are not some in View, will find, if he takes the least Notice, that it rains in the Hills before it rains in the Vales: What can be the Cause of this Rain? Nothing, doubtless, but a Wind blowing from the Vales towards the Hills; that is, from a warmer to a colder Region, where the Vapour, which is brought thither, falls. Suppose the Air over the Hills be cold in 20 Degrees, and the Air over the Vales but in 10 Degrees, 10 cannot outweigh 20; but,

but, if it gets an additional Force of 30, it will then be double the Strength of 20; and, consequently, blow from a warmer to a colder Quarter.

The *Momentum* of every Thing that moves, is made up of Two Powers, Weight and Velocity, multiplied by one another. This is fully shewn in the Butcher's Stiliard, which, with a Weight of 5 Pound, will weigh 100 Pound, by placing the 5 Pound Weight 20 times farther from the Centre, than the Thing to be weighed is placed: For 5 Pound the Weight multiplied by 20, the Velocity is equal to 100 Pound. Supposing then that the Cold to the North-east of us be 100, and the Cold which drives the Trade-wind, only 5; that is, that the Cold of the one Place be 20 times greater than the Cold of the other: But supposing the Air 5 Degrees cold, to move 20 times faster than that which is 100 Degrees; upon this Supposition the *Momentum* will be equal: And since they move in direct Opposition to one another, they will meet exactly half way, which I take to be sometimes near the Case. But if the Northern Power should lose one Half of its Weight, *i. e.* be milder, by one Half, one Winter than it is another, the other Power still continuing the same, then the South-west will blow one Half farther.

I am aware of but one Objection more, which is, that in the Gulph of *Florida*, through which I suppose the Trade-wind to flow towards us, there are variable Winds, which must interrupt this Stream, if there be any; since the same Air cannot flow different Ways at the same time.

It is no new thing to have variable Winds near the Land, even in the midst of the Way of the Trade-wind.

wind. The Westerly Winds, which, as *Dampier* says, blow on the Coast, between Cape *Gratia de Dios*, and Cape *La Vela*, are a Proof of it. The common Trade-wind on this Coast is between North-east and East; but from *October* till *March*, and chiefly in *December* and *January*, the Winds blow West; and yet when they are longest and strongest on the Coast, the Easterly Trade-wind blows off at Sea, as at other times. Near Cape *La Vela*, the true Trade blows within 8 or 10 Leagues off the Shore, when the Westerly Winds blow on the Coast. This shews that these Land winds reach but a little Way, and therefore can have but a small, if any, Influence on the main Stream of the Trade-wind.

In smaller Navigations here in *Europe*, they find the Wind out at Sea different from what it is near the Shore, and especially near Head-lands, where it generally blows hardest, and which helped to make the Navigation of the Antients, in the *Mediterranean*, so tedious and dangerous. These variable Coast-winds may be owing to great Snows, or Rains that fall upon Highlands, when there is none, or little, at Sea, or to some Storms of Thunder that burst over them, or to their natural Coldness, or even to the Repercussion of the Air. I take the variable Winds they meet on the Coast of *Florida*, to be owing to the like Causes, which have their Influence but a little Way.

But it may be said, that these variable Winds on the Coast of *Florida* are found so near the Trade-wind, that there is no Room between them for the Eddy of the Trade-wind, I am speaking of, to pass out. It may be Fact, for aught I know: I will suppose

pose it to be Fact. But I desire the Objector to consider, that, when he is sailing, he is on the Top of the Water, and at the Bottom of the Air; he perceives the Current of Water run very fast at Top, but does not know how it runs at the Bottom. It is very certain, that there are Under-currents in Water: In Rivers that ebb and flow, it is perceived every Tide; for the Current will run up after it hath begun to ebb. By Experiments that have been made, it appears, that in some Places, where the Current on the Surface is very strong, the Under-current, running quite the contrary Way, shall be much stronger, and carry away a Boat against the Force of the upper Current.

And why may there not be contrary Currents in the Air? An Element much more subtile than Water, and therefore capable of being put into a greater Variety of Motions. The Sailor concerns himself no farther with the Wind, than as it fills his Sails, the Height of which can bear but a small Proportion with that Column of Air I am now speaking of. The Land-breezes about Islands, in the Torrid Zone, shew different Currents in the Air. For, in the Night, the Wind shall blow from the Centre of the Island, every Way, into the Sea, and even in direct Opposition to the Trade-wind, and yet give no Interruption to the Progress of it, except just in that little Spot, and for a small Height too; which is evident from hence, because in sailing to the Westward of *Barbadoes*, suppose, or *Jamaica*, without the Reach of the Land-breeze, you feel no Interruption in the Strength of the Trade-wind, by Night as well as by Day.

I, who am one of no great Observation, have frequently seen different Currents in the Air, at the same Time, and in the same Quarter, under one another. For Example: When the under Current has been East, the upper Current has been South-west, and the middle South-east. I shall appear ridiculous, if I say I see the Wind; the Vulgar-think, that Swine only are endowed with that Quickness of Sight. I do not say, that I can see the Wind; but I have often seen Clouds, Weather-cocks, Smoke, and such-like Things, that are either carried or turned by the Wind. Smoke and Vanes are so near, that they can hardly cause any Deception; some Clouds may, unless properly observed: For when there are Two Tires of Clouds, both carried the same Way, and with the same Velocity, the upper Tire shall appear to move directly contrary to the lower; which Deception is owing to the different Angles that Objects of the same Magnitude, at different Distances, make on the *Retina*.

The way to observe the Motion of the Clouds, is by looking at them and a fixed Object at the same time, as the Sun and Stars, sometimes: The best superior fixed Object is the Moon in her Quarters, which may be then seen by Day-light, without offending the Eye. The fixed Objects below the Clouds are, a Ridge of Hills, lofty Buildings, or, for want of them, a Tree. By observing a Cloud with any fixed Object, you will not only see on what Point of the Compass the Clouds pass; but you will see also the Motion of the upper and under Current: By this means you will find, as the Case happens, either both Currents going the same Way, though with different

apparent Velocity; or the upper Current going one Way, and the lower another, and perhaps you will see the Smoke going a Third. This sufficiently shews, that there are different Currents in the Air.

From all my little Observation I find, that the upper Current generally prevails. For though the under Currents from, suppose, the East, or even North-east, be brisk at first, and the brisker they are at first, the longer they continue; yet they die away by degrees, as their Strength spends itself; the Air becomes near calm, and then the South-west, which before blowed aloft, descends to the Earth, and commands the whole Sky.

That the Disorders of the lower Air do not affect the Stream above, appears also from the Trade-wind passing over the very Continent, from the Eastern to the Western Side of *America*. I make no doubt but the high Hills of *Peru* cause a greater Variety of Winds and Weather, than we have here. Their Western Sea shews, that the lower Part of the Trade-wind meets with great Obstructions in passing over the Continent. For, as *Dampier* observes, you do not meet with the true Trade-wind, till you are got 150 or 200 Leagues from Shore; and then it blows in its usual manner. If all the Disturbance that the high Hills of *Peru*, said to be the highest in the World, give to the Trade-wind blowing over them, cannot intercept the upper Stream, which, after surmounting all those Heights, and the Disorder that their Cold occasions, stoops down again, till it comes to touch once more the Surface of the Ocean; we may easily suppose, that that Part of the Trade-wind, which is reflected from these Hills towards the North-east,

east, may disengage themselves, in like manner, from all inferior Obstructions, and fly over all the little low Disorders of the *Floridan* Coast.

Upon the Whole, then, though I cannot pretend to find out the Angle of Incidence, yet I must conclude, that the Trade-wind is reflected in such a manner as to cause our South-west Wind.

And I conceive, that this new Direction is so far from checking its Current, that it the rather increases it. For a great Part of the cold Air, that hangs over the Continent it strikes against, having no other Vent, flies off with the Eddy, and thereby makes more than Amends for the Stop it gave.

From *America* to the West of *England* this Wind glides over the Ocean, a plain Field, that gives no Opposition, and which, with its natural Warmth, encourages the Waft, by making the Air over it more ready to yield to the impelled Force.

Having thus opened a Passage for the Trade-wind to flow even to us, with a back Stream, if my Conjecture hath opened it; what I have said may serve as a Hint to those who have better Materials, and can make a better Use of them: But, admitting that my Conjecture is right, we have the Cause why the South-west Wind blows with us; and then there can be no great Difficulty in finding out the Reason why it brings so much Rain.

For this Wind blowing over a warm Ocean, which sends up many Vapours, by the time it reaches us, comes charged with an infinite Swarm of watery Bladders, which the Cold of this Climate condenses, and then down they fall in Showers of Rain.

From hence it appears, that the Two great Rulers of the Weather with us are the North-east and South-west Winds. Like Two neighbouring potent Monarchs, they are engaged in eternal Wars: Sometimes the one pushes his Conquest with great Rapidity; and sometimes the vanquished Power not only recovers its lost Dominions, but carries on the War into his Enemy's Territories with great Success. As we happen to lie near their Frontiers, we feel, by turns, the different Effects of their fierce Contention: Some Years we have a Run of North-east Winds, frosty Winters, and dry Summers; and some Years the Reverse of all this.

But if I have hit upon the true Causes of these Winds, yet the Question will be, On which Side lies the Redundancy, or Failure, that makes all this irregular Variation? For, between Two Antagonists, the Advantage will be the same to the Conqueror, whether his Superiority be owing to his own Strength, or the Weakness of his Adversary. I would be glad to find this out, but I doubt that all my little Search will not be able to do it. I will proceed as far as I can.

Let us suppose, in the first Place, the North to be intirely passive, and that all the Variation of Cold and Heat is owing wholly to a Defect, or Excess, in the South-west Wind: So that, when the South-west blows, it shall be always warm; and, when it ceases to blow, it shall be ever cold. If this be Fact, then it will follow, that whilst the South-west blows with the same steady Gale, the Weather shall be of the same Degree of Heat: But we find it otherwise; for the Nights, in a mild Winter, are colder than the
Days,

Days, the same South-west still blowing ; therefore Cold, with us, is not wholly owing to a Slackness of the South-west Winds.

Let us now suppose the Privation of the Sun's Heat to be the only Cause of Cold: The Consequence will be, that all Places equally distant from the Sun, will be equally cold. But it is well known, that, in the same Northern Latitude in *Europe*, Cold is greater on the Continent than in Islands : Therefore Privation of the Sun's Heat is not the only Cause of Cold. The Sun's Absence, like other negative Causes, can amount only to the Removal of an Obstruction which hindered the efficient Cause of Cold, whatever it be, from acting.

Since the larger the Tract of Earth, the greater the Cold, the efficient Cause of Cold seems to be in the Earth ; and yet, when we descend a little Way under-ground, not only in Mines, but in some Cellars, we find an even Temperament : We must therefore confine this efficient Cause of Cold to the Earth's Surface.

But if the Earth's Surface be the sole efficient Cause of Cold, since the Surface of the Earth still continues the same, the Cold should be the same on that Surface every Winter ; whereas we find it otherwise. We must, therefore, seek for some concurrent Cause, between whom and the Earth's Surface this Cold is generated ; and that, I think, can be no other than what is carried on the Wings of the Wind.

Dampier observes, that, after a *Tornado* at Land in *Jamaica*, the Land-wind will begin by Four or Three o'Clock in the Afternoon. The Materials of
this

this *Tornado* must be carried thither by the Wind ; where the *Tornado* bursts, it cools the Air ; which makes the Land-breeze begin some Hours sooner than its usual Course.

That the South-west Wind, warm as it is, carries with it the Seeds of Cold, is evident from those violent Storms of Thunder, attended with great Rains, and large Hailstones, several of which happened this last Summer.

The 8th of last *September* was a cold Winter's Day at the Place where I dwell. In the Morning, when I awoke, I perceived a great Dew on the Inside of the Glass of my Chamber-window : When I went out, I observed the Wind to be North-east, strong, black Clouds, and little Rain early, rest dry. 9th in the Morning, the Wind was North-east, brisk, dry. I began to think, that the Winter was going to set in very severe ; but I was in a little time undeceived. The Afternoon of the 9th was overcast. On the 10th, I saw Colts-tails, as the Sailors call them : I take them to be *Virgil's Tenuia lanæ vellera* : Marks of Rain, that seldom deceive those who are used to observe them. On the 11th, the Wind returned again to its old Point of South-west, with Rain. Some time after, I did read in the News-papers, that on the 7th a violent Storm fell about *Worcester*, which is distant from hence about 2 Degrees, and bears, nearly, on the North-east Point. Then I found out the Cause of that little Winter.

I could mention more Facts of this Kind, but these, I believe, are enow to satisfy us, that the Seeds of Cold are carried on the Wings of the Wind. It will be needless to take notice, that the Wind carries the
Cold

Cold back again : Every one who feels his Hands tingle in a frosty Morning, and looks at the Weather-cock, must be sensible of it.

Since, therefore, a large Surface of Earth to the North of us, assisted only with a Privation of the Sun's Heat, cannot produce Cold to so great a Degree, as to affect the Weather with us ; and since it appears, that that which is to help these Two Causes to produce such a Cold, is brought by the Winds, and carried off again ; I must conclude, that there are frigorific Particles floating in the Air, whether they be Nitre, or by whatever Name the Chymists will call them ; that they are always acting, unless obstructed by other Causes ; and that, when they find a proper Recipient, and all Obstructions be removed, they act with Vigour.

When I speak of the Seeds of Cold, I do not mean, that Cold acts as a Vegetative : Though whoever considers the Order that Frost observes in building its Ice upon the Water, will be apt to think, that if it be not the Effect of Vegetation, it is something that resembles it very near.

It first shoots out a small strait Twig ; then, from the same Centre, one on each Side ; from these main Beams dart out smaller Sprigs on each Side, to form the Contignation ; then these Rafters sending forth their Sprays, the whole Floor is laid, weak at first ; but as they gather Strength, they make a Plancher, strong enough, sometimes, to bear the Weight of whole Armies passing over the *Baltic*.

I do not expect, that the Ladies will expose themselves so much to the Cold, as to see all this : But if they please to give themselves only the Trouble to
look

look on their Chamber-windows in a frosty Morning, if they rise soon enough, and they will see there such Embroidery made by Ice, as their own Fingers, were they used to work, and the finest Needles, could not equal.

All this, I say, would tempt one to imagine, that there is something vegetative in what I call the Seeds of Frost. But that is not what I am about at present. All I contend for now is, that that which co-operates with the Earth's Surface, to produce Cold, which way soever it produces it, is carried to and fro by the Air.

Instead of their acting like Seeds, let us suppose them to act like inanimate Bodies: That each Particle acts with a determined Force; and that, consequently, the more of them act together, the greater their Effect. Upon this Supposition we can easily account for the different Temperament of the Air in the same Seasons. For a Continuance of North-east Winds for some Years will carry off many of these Seeds, or Grains of Cold; and an equal Continuance of South-west Winds will bring them back again; and these Periods will be longer or shorter, according to the Strength or Weakness of the Blast.

And thus, at length, I have satisfied myself, till I can find out a better Reason, why a cold frosty Winter produces a dry Summer; and a mild Winter a wet Summer. For these Seeds of Cold being the chief Cause of Frost, and their Strength being in Proportion to their Number, when the Winter is severe, there is so vast a Quantity of these frigorific Particles in *North-Europe*, that their Strength will not soon be exhausted; and, consequently, that the North-east
Winds

Winds will blow long, and make the Summers dry.

But, on the contrary, when the Winter is mild, there are but a few of those Particles in *North-Europe*, not enough to cool the Air there to such a Weight, as to enable it to hinder the South-west from reaching us, even in Winter; and therefore, when once the Sun's Heat comes to destroy those few, the South-west, which is always acting with equal Force, prevails, and brings Rain in Summer.

I make no doubt, but that a Course of Observations, kept for some Years, in several Places, would reduce the Knowledge of these Vicissitudes of Wind and Weather to some Certainty.

I have taken notice only of Two Winds, the North-east and South west, as the Producers of a long Run of dry or wet Weather: But if I have hit upon the true Causes of those Winds, the smaller Variations may be easily accounted for. I shall mention a few.

Next to those Two, the North-west Wind blows longest here, and with the greatest Force, but with various Effects. Sometimes it conspires with the South-west, to blow a mere Storm, with hard Rain; and sometimes it takes part with the North east, blows dry, and freezes. We are, in a great measure, beholding to this Wind, for the little dry Weather we have in a mild Winter.

I take this Wind to proceed from the Continent of *North-America*, where the Cold must needs be very intense, that can drive the Air from thence hither, with such strong Gusts. It is well known, that Places of the same Northern Latitude are much

colder in *America* than in *Europe*. Upon Supposition that the North-west Wind blows from *North-America*, I can, methinks, easily account for all these contrary Effects produced by the same Wind.

Though it blows from a cold to a warmer Quarter, yet it brings Rain at first, for this Reason, because the Air over the Ocean about us is warmer than that over us. When the North-west begins to blow, it must drive the Air before it; and then the Vapour that floated in warm Air will fall down with us. Even the North-east, the driest and coldest Wind we have, will bring Rain, and for many Hours, when it sets in after a South-west.

Hence also it is that the South-east and South Winds bring much Rain, and for many Hours together. I take the South-east to come from the *Alps*, and the South from the *Pyrenees*.

I shall, at present, run no farther into Particulars; my Design being only to inquire into the Causes of a long Continuance of dry or wet Weather. It would be endless to enter into all the Predictions of Weather, that may be collected from Books, and private Observations: Most of them pretend to foretel the Weather no farther than a few Days. If those Predictions and my Hypothesis be founded on Nature, they will all admit of the same, or of a consistent Explanation.

N. F. Dec. 31. 1735.

XI. Notabilia *quædam* in Itinere Alpino-Tyrolensi *observata* per Balthasarem Ehrhartum, M. D. Memingensem in *Epistola* ad C. Mortimerum, R. S. *Secr. missa.*

GRatissimas tibi persolvo grates, quod * marmor illud nitidissimum juxta meam tenuem sententiam non belemnitis, sed trochitis prægnans, amicissimis tuis responforiis comitari volueris. Istis vero quoque nunc tardius oppositas meas hæc non dedignaberis; cum enim ITER CURIOSUM ALPINUM TYROLENSE nuper susceperam, annotata quædam in eo facta, prius aliququaliter digesta, tecum communicare constitui.

1. Emenfis pluribus Alpibus, Helveticas altitudine æquantibus, itinere quinque dierum, nulla mihi, ad hoc unum obtento, occurrissæ marina petrefacta, vel conchitas vel nautilitas; Woodwardi hypothesin in plurimis falsi arguit. An non & maris tractus æque spatiosi dantur incolis vel animalibus marinis plane vacui, ob venas metalliferas, bituminosas, vitriolicas, ibi uberius in mare hiantes? Ex quo fundamento remedium proceribus Belgiarum, contra Xylophagum aut marinam teredinem propalare ante biennium, scripto copioso, sustinebam. Sed deerat mihi patronus, cui id commendarem.

2. Pro sermonibus illis ex sacra cathedra, instituto apud vos Boyleano, ad convincendos atheos faciendis, non infimum providentiæ divinæ argumentum largiuntur Alpium discrepantes qualitates. In toto itinere

* *Marmoris* sc. Darbiensis *frustum* ab *Illustrissimo D^{no} Hans Sloane dono missum.*

unicum vidi montem, *Heenberg*, i. e. fœniferum dictum, prope pagum *Pichelbach*, via publica; qui, mirabile dictu, non in summo tantum, sed per omnia latera ad infimam usque basin, fœnificium tam largum præbet, ut pluribus adjacentibus villis, fœno æstate collecto, pro pecoribus per hyemem eo pascendis, inserviat. Deprehendi mechanismum, partim humi alentis spissioris eum regentis, partim subjacentium huic luti margæque venarum, uberrimam laticis fontani copiam, per omnem montis ambitum, subtilissime exsulantium, eo continuo pororum nexu, quo siphon inflexus, facta a vicinis altioribus montibus derivatione, imitatur. Novimus enim stratis luti argillæque subterraneis, DEUM, conditis naturæ legibus, sub terra in ducendis fursum deorsumque aquis, id præstare, quod homines canalibus ligneis plumbeisque satagunt. Addo his rationibus & illam, quod in isto monte minor vaporum metallicorum, vegetabilium aliàs radicibus obnoxiorum, prosteret copia. Attamen, his quoque concessis, nullam video rationem, quod inter centenos alios montes, retro citroque nullus detur, qui huic mira fertilitate comparetur. Ubi ergo hic necessitas physica absoluta? Plane nulla. Sed specimen est liberæ voluntatis divinæ, ejusque providentiæ.

3. Directionem stratorum faxeorum aliis in montibus, nimium sæpe, ut dixi, ob cautium steriliū copiam Libyæ desertis comparandis, sæpe considerans, miram observavi stratorum, ex parallelo, obliquo, perpendiculari, perque omnes angulos variationem. Mirum, juxta Woodwardum, strata omnia post diluvium exacte ad centrum terræ circularia, vel parallela fuisse; hodie vero rarissimum dari adhuc stratum, a diluvianis illis recens formatis residuum, cujus
purus

purus parallelismus saltem per exiguam terræ lineam, vel ad spatium unius horæ repertus fuerit. Novi quam diversa ab isto expertus fueram, dum hujus præcipue studii gratia Germaniam ante decennium cruciatim, Tiguro Hamburgum, & Dresda Amstelodamum usque peragrabam, jactis prius hic necessariis physices fundamentis, & perlectis numerosis auctoribus oryctographis. Interea ex phænomenis illis nuperi itineris Alpini vidi perspicue, varietatem illam stratorum faxeorum, quibus Alpes componuntur, iterum benignitatis & providentiæ divinæ documentum esse irrefragabile; cum si horizontalia essent montium strata, eorum ruina quotidiana esset, summo incolarum & peregrinantium damno. Contra vero tam mire varianti positu stratorum, eoque maxime ex *lineis quasi vergentibus* conflato, montes nunc studio æternitati fructos, sole clarius apparere.

4. Demonstrari posse differentiam stratorum ejusmodi mundo creato cœvorum, aliorumque post-diluvianorum, nullus dubito. Hic Memingæ montes habemus, plusquam media summarum montium altitudine gaudentes, qui in summo quoque cacumine strata vastissima habent ex lapidibus meris palmaris circa, sed variantis magnitudinis, cæterum rotundatis; illorum plane instar in modum, qui a fluviorum cursu & attritu sic formantur, & in Peireskii vita, errore Gassendi, ex muco, nescio quo, fluviatili concreescere demum, lepida fabula, narrantur. Jam pro demonstrato habemus lapidum illorum omnium vastissimam congeriem quasi supramontanam, cum fluviolus nullus ibi pertingat, ab aquarum torrenti formari haud potuisse. Multo minus formationis illius medium, quem in Acad. Reg. Paris. Commem-

tariis

tariis Dn. *de Reaumur* ingeniose protulit, hic locum habere posse. Accedit enim alterum a me detectum phænomenon, quòd a Meminga versus Alpes lapides istos diametro crescentes deprehenduntur, sic ut tandem massas vel truncos triquadripedales æmulentur; sed a Meminga versus plagam oppositam, & ab Alpibus remotiorem, decrescit magnitudo istorum lapidum, successive semper minorum, usque dum denique ad arenæ grossioris speciem recedant. Hanc insignem pro telluris theoria observationem augeo sequentibus partim observatis, partim corollariis.

Integra observavi inter Tyrolenses Alpes montium juga, quæ in *continua* rupe eo præcise gaudent lapidum genere, quo ultimo dicti illi inter Alpes & Danubium siti montes gaudent in *discretis, detritisque* lapidibus.

Lapidum istorum tot varietates sunt, quot rupium illarum Alpinarum.

Causa quæ rupes Alpinas fregit, & fragmentis inde, raptu undarum mutuo attritu rotundatis, totam meam, quam inhabito, Alemanniam, inundavit, nulla alia quam diluvium maximum, dubito tamen an Noachicum, esse poterit.

Talis diluvii undæ, in eodem tractu, viginti leucarum longitudine, nec minori latitudine, tum temporis, eadem directione ab austro ad septentrionem dirigebantur.

Tum attritu undarum vorticumque ex conflatis Alpibus, ante diluvium duplo altioribus, orta fragmenta, quo magis provolvebantur, eo magis comminuta sunt. Unde loca Alpibus vicina majoribus frustis premuntur; ab iis vero remotiora, minoribus, imo fere in grossioris arenæ formam comminutis gaudent.

Ex-

Exactissima similitudo istorum quovismodo comminutorum lapidum; & rupium Alpinarum maximarum, ceu ex ruina superstitum, illorumque patriam repræsentantium; oculariter demonstrari potest.

Inter illa tamen notabilissima frustra, quibus integra Sueviæ superioris provincia inundata est, hætenus nulla vidi ex vena metallifera conflata, prout inter Alpes integri montes largus metalliferi dantur. Ergo ante diluvium aut venæ metalliferæ superjectis montium molibus tectæ erant, aut in frustis illis exspirârunt ramenta metallifera. Metallicolæ ista *exspirare, Verwittern*, vocant, quod explicatu facile erit suo loco. Unde tot inter illos lapides Alemannicos occurrunt, favaginis instar foraminati ubique & exesi.

5. Plantas inter rariores, Alpinas, in itinere isto, mensis Septembris initio, occurrerunt :

Acetosa lanceolata, Alpina, rotundifolia. N. Acini pulchra species. J. B. 3. 260. Cacalia tomentosa. C. B. 198. Cardamine Alpina. Clus. Pannon. Caryophyllata Alpina chamædryos folio. Boerh. 45. Cotoneaster. J. B. 1. 73. Cratægus folio subrotundo serrato, subtus incano. Tourn. 633. Daucus montanus multifido longoque folio. C. B. Diospyros. J. B. 1. 75. 1. Myrtomelis Gesneri. Doria quæ Jacobæa Alpina. C. B. Pr. 66. Erica arborefcens, floribus luteolis vel herbaceis. J. B. 3. 356. Horminum luteum glutinosum. C. B. 238. Larix folio deciduo conifera. J. B. Chamærhododendros Alpina villosa. T. 604. Quinquefolium album 1. Clus. J. B. 2. 398. Pinastr Alpina pumilio. Clus. Pannon. Sedum minus flore luteo. J. B. 694. Siler montanum minus. Boerh. 52. Vitis Idæa foliis oblongis albicantibus.

C. B. 470. *Gallium saxatile supinum*, molliore folio.
A. R. P. 1714.

6. De fodinis salis Halæ Tyrolensium a me perlustratis pauca hic refero. Dum quilibet inter Alpes mons mundum integrum repræsentet, suumque clima torridum, temperatum, & frigidum habeat; illa jugi montani pars, quæ salis fodinas continet, austro exposita est summopere, solibus æstivis in pluribus lateribus torretur, mea sententia magis, quam terræ lineæ æquinoctiali subjacentes.

Concomitatus, vel nexus, ac συζυγία fossilium, phænomenum est hætenus parum notum, sed singulare, ac nullibi negligendum. Halæ Saxonum salinas comitantur grysci lapides argillofi, molliores; desuper strata jacent lapidis rubescentis marmorei nonnihil, cui glomeres quasi spathi aut seleniticæ materiæ innascuntur. Non procul a salinis, copia bituminosi fossilis aut carbolithi præsto est. Sic & Halæ Tyrolensium tum magna voluptate similem plane fossilium concomitatum observavi, differentia nulla inter illas atque has, quam quod ibi ab ipsa natura, hic artis ope, aqua sale fossili saturetur. Salis enim vena vel fossile sal hic obveniens cœnosum, cameris subterraneis eum in finem excavatis elutriatur, & ex myria hoc modo parata sal coquitur. Mirabile dictu cœlum cameras ejusmodi tegens, lapideum esse, pavimentum vero argillaceum. At ejusmodi structura plurimæ Alpes gaudent quibusdam partibus, ut iterum potentiæ divinæ ab humana architectura diversissimæ documenta largiantur. Sed falsa est Bècheri relatio, spoliatas sale fossili per aquæ admissionem cameras subterraneas vel cuniculos, subinde dein renato sale iterum repleti. Hoc vero primus ego detexi, ex limo illo nigro, sale fossili interjacenti per elutriationem pri-

privato, efflorescere dein nitidissimis ubique aculeis sal amarum Epsoniensi ex asse simile, ut Tyrolenses, si vellent, ejus maximam quantitatem parare, ac reliquæ Germaniæ id in locum Anglici salis surrogare possint. An tamen alicubi sub terra sal fossile adhuc generetur per modum vaporum, nondum rescire potui: Ipsi tamen fossiores de suffocantibus subterraneis halitibus nil sciunt, quos in Saxoniae metallifodinis notissimos habent, & *Schwaden* vocant.

Unicum addo, de dialecto linguæ Alemanicæ vel superioris Sueviæ; eam tot diphthongis, talibus pronunciandi modis, & vocibus plane similibus gaudere; ut qua literam, Anglicæ, præcipue Wallicæ linguæ, simillima sit illa, simulque omnium maximum documentum præbeat, Suevos & Anglos antiquissimis temporibus unam eandemque fuisse nationem. Quod ex historiis ob vetustatem probare difficile, ex isto vero argumento facillimum erit. Cujus tamen explanationem alii tempori reservo.

Nunc jam nimiam epistolæ prolixitatem, vir eruditissime, deprecor. Nolui saltem, tuo jussu excitatus, qualibuscunque meis indiciis Regiæ apud vos societati levidenses in H. N. conatus meos designando deesse. Tuæ vero dominationi, propter veteris amicitiae documenta, obstrictissimus manebo. Vale & fave; quamque primum negotia permiserint, rescribe. Datum Memingæ, die 10 Maii 1735.

L O N D O N :

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Fig. 2.

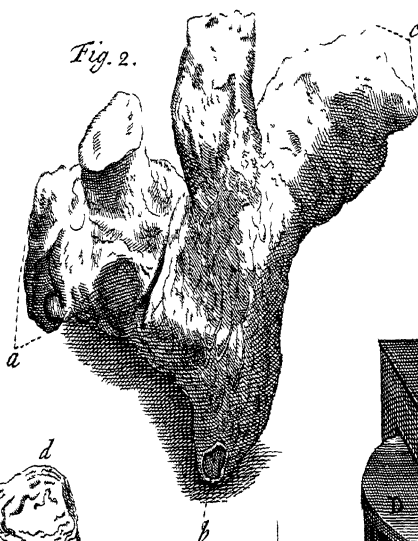
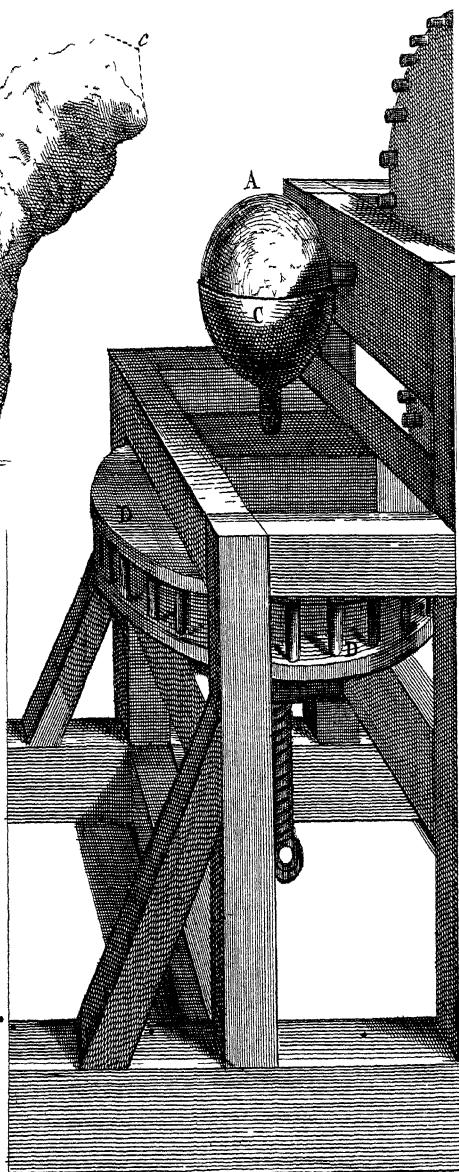
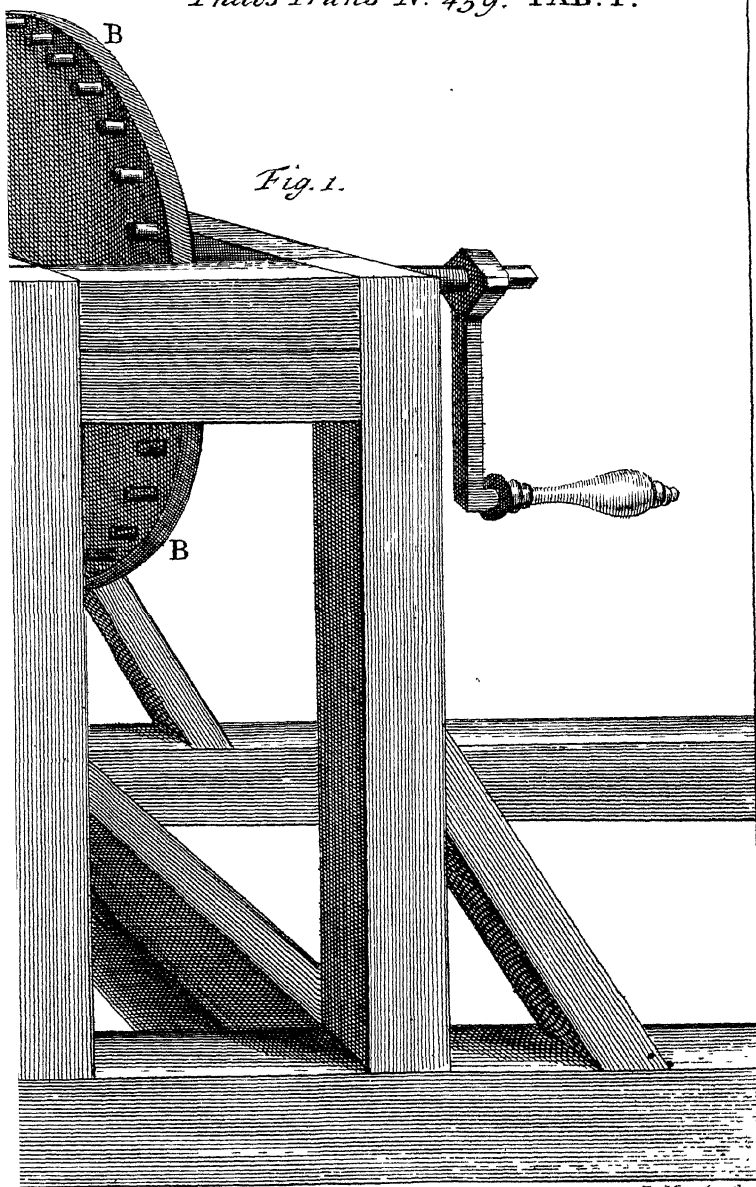


Fig. 3.

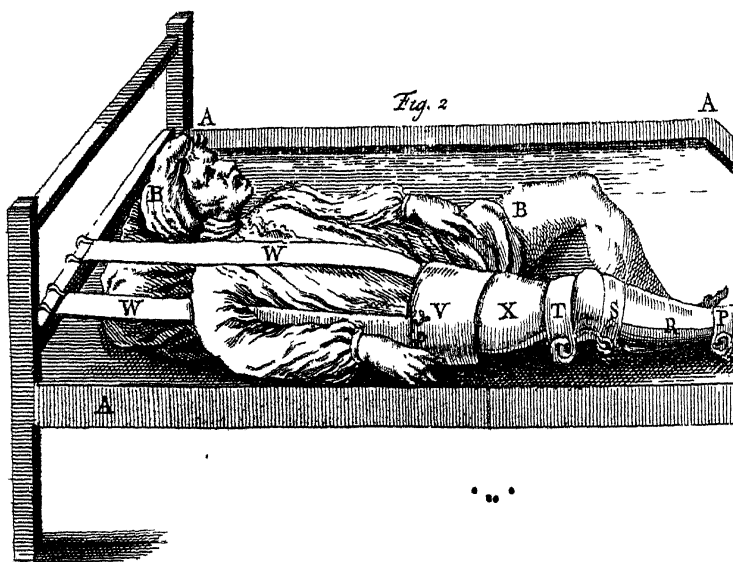
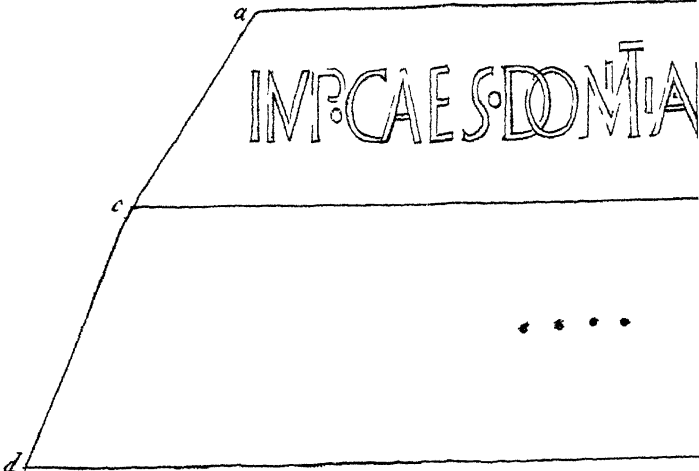


Fig. 4.





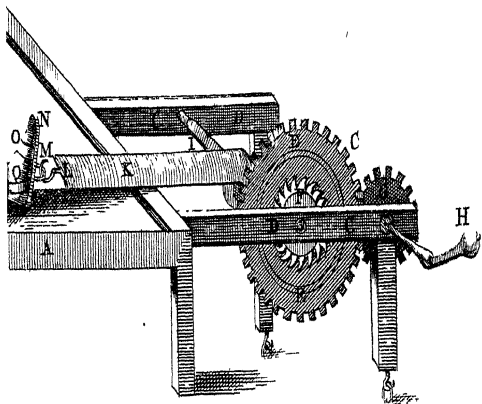
TAB. II.



Henry Etterick delin

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Fig 1.



J. Mynde fecit.

Fig. 1.

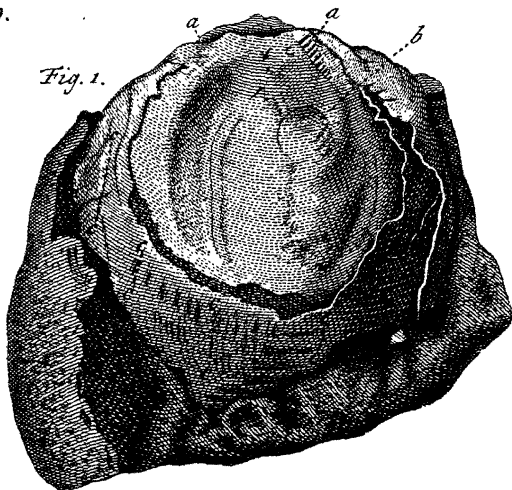


Fig. 2.

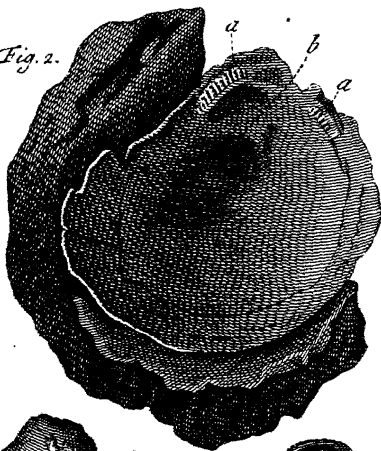


Fig. 5.

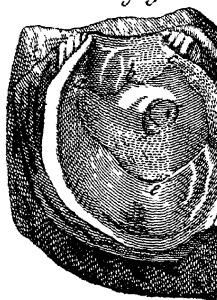


Fig. 4.

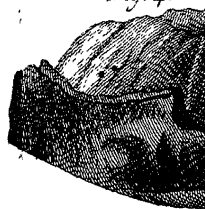
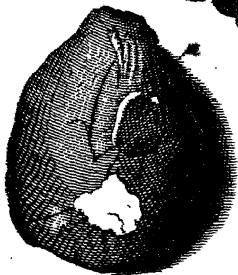
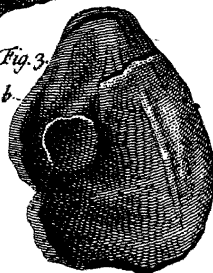


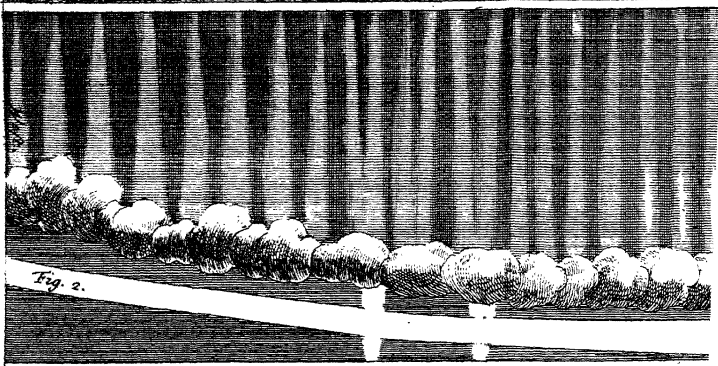
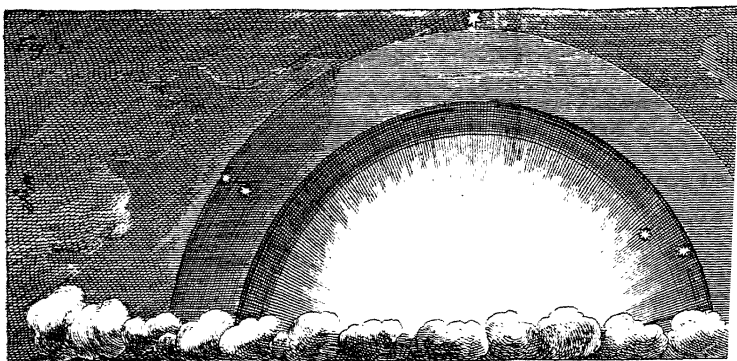
Fig. 3.



TAB. III.

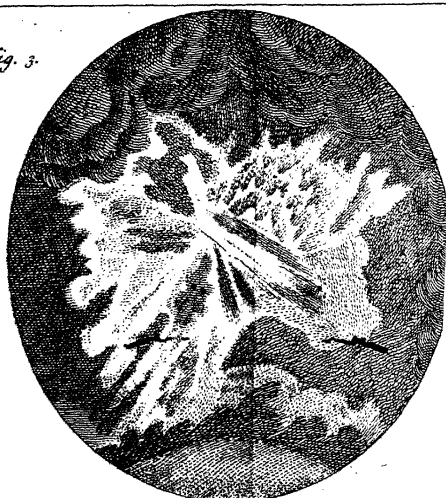


J. Mynde sc.



Philos. Trans. N^o 459.

Fig. 3.



North

PHILOSOPHICAL TRANSACTIONS.

For the Months of *January, February, and March,*
1741.

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I. *The Figure of a Machine for grinding Lenses spherically, invented by Mr. Samuel Jenkins, and communicated by him to the Hon^{ble} Sir Hans Sloane, Bart. Pr. R. S. &c.*

S I R,

THE Advantage it would be to have *Lenses* of the spherical Kind, Segments of a true Sphere, hath occasioned the Invention of many Machines and Methods of Grinding, in order to produce such Segments: But nothing hitherto made public hath answered the End proposed.

The best Methods now in Use will only produce an Approximation to a truly spherical Figure, but demonstrably not one, though the Artificer should employ the utmost Skill and Care in the Use of the best Machines hitherto invented: And indeed, at present, Gentlemen have nothing to depend on, that their *Lenses* are nearly spherical, but the Care and Integrity of the Workmen; in which how often they are deceived, is too obvious to every one who hath Occasion to use such *Lenses*.

I therefore beg Leave to submit to your Consideration the Effects of a Machine, of which the inclosed is a Representation [TAB. I. Fig. 1.]; which, as it is contrived to turn a Sphere at one and the same time on Two Axes which cut each other at Right Angles, with equal Velocity and Pressure on each of them, I conceive it is demonstrable, that (without any Skill or Care in the Workman) it will produce a Segment

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ment

ment of a true Sphere, barely by turning round the Wheels; which if so, the Consequences will be,

1st, That all Grinders of such Glasses, &c. will gladly use them; a labouring Man, whom they hire for less Wages, being, by the Help of this Machine, able to do more Work in a Day, than a skilful Artificer, without it, in Two Days. And,

2^{dly}, All Gentlemen will have the Pleasure to know the *Lenses* they make use of are truly spherical, it being impossible this Machine should produce any other Figure.

If you think this Contrivance of Importance enough to be offered to the ROYAL SOCIETY, you will do me a great deal of Honour to communicate it from,

S I R,

Essex-Court,
Nov. 29. 1737.

Your most obliged

Humble Servant,

Samuel Jenkins.

Explanation of Fig. 1. TAB. I.

A. *A Globe covered with Cement, in which are fixed the Pieces of Glass to be ground.*

This Globe is fastened to the Axis, and turns with

B. *the Wheel B.*

C. *Is the brass Cup, which polishes the Glass: This is fastened to the Axis, and turns with*

D. *the Wheel D. So that the Motion of this Cup C is at Right Angles with the Motion of the Globe A.*

II. Ob-

II. *Observatio de immodico & funesto Lapidum Cancrorum, similiumque terrestrium Absorbentium Usu, indeque ortis Calculis in Ventriculo & Renibus: à Joh. Philippo Breynio, M. D. R. S. S. cum D. Hans Sloane, R. S. Pr. &c. communicata.*

NUllam fere in corpore animali dari cavitatem, in qua non aliquando calculi generati & reperti sint, practicorum testantur observationes; immo quotidianus clamat rerum usus.

Inter ratiores tamen merito numerandi sunt calculi, qui in ventriculo corporis humani generantur. Horum nonnullæ licet in lucem, a quibusdam viris doctrina & arte claris, jam editæ sint historiæ, quædam quoque tibi, Vir Illustris, non ignotæ proculdubio fuerint, non tamen me oleum & operam, quod aiunt, perditurum confido, si sequentem tecum communicavero; utpote quæ tum ratione originis, tum configurationis calculorum, quotquot hætenus publicatæ sunt, varietate, quantum ego novi, superare videtur. Generosus nimirum D. Robertus Hæcker Anglicus, Eques Auratus, corporis constitutione athletica, & valetudine gaudens prosperrima, (nisi quod aliquando cum morborum tyranno, podagra scilicet, misere conflictaretur) genio suo, ut sæpius solent Generosi, vinoque subinde indulgens, in insula Americæ Barbados dicta, quæ Britannorum paret imperio, degebat. Hic a multis, jam annis subinde, inprimis si Baccho liberalius aliquantulum litaverat, cardialgia, quæ

Anglis, apto satis, vocabulo vernaculo, *Heart-burn* salutatur, corripiebatur; ad quam tollendam pulverem oculorum cancerorum, similiave acidum obtundentia terrestria frequentius assumebat. Ex his levamen quia pro tempore saltem observabat, indies redeunte cardialgia, lapidum cancerorum, cretæ, testaceorum, & similium usum singulis diebus in magna dosi per plurimos continuavit annos: sed funesto plane eventu; cardialgia enim non tantum inde increvit, sed & molestissimus gravitatis seu ponderis sub diaphragmate sensus accessit, concómitantibus subinde vomitu & intensissimis doloribus nephriticis; donec tandem, anno ætatis suæ quinquagesimo sexto, post natum Christum vero, si recte memini, 1694. misere excruciatum animam redderet.

Cadaver, cum agnotorum venia, a duobus chirurgis, fuit apertum; qui in ventriculo ingentem calculorum variæ admodum magnitudinis reperere numerum; quorum maximus magnitudine, & figura ramosa, qua corallium exprimit, imprimis notabilis, figura 2. TAB. I. exhibetur; prouti a filio patientis, Generoso D. Wilhelmo Hacket, hospite quondam, dum Oxonii degerem, meo amantissimo, cui totam hanc historiam debeo, anno hujus sæculi tertio asservabatur, mihiq; cum cæteris demonstrabatur, qui, deperditis licet aliquot, ut figura indicat, extremitatibus, uncias tamen medicas adhuc pendebat duas cum drachmis quinque.

Hic proximus fig. 3. expressus unicam unciam cum una æquabat drachma. Cæteri vero longe minores, a magnitudine scilicet seminis papaveris ad pisi majoris, ascendebant, sphæricæ, vel ad sphæricam accedentis figuræ.

Hi calculi omnes in ventriculo involuti fuerant humori admodum mucoso, & tenaci, qui in charta aëri expositus & siccatus abiit in pulverem simillimum substantiæ dictorum calculorum.

Substantiam verò eorum quod attinet, notandum est, eam non ubique fuisse eandem; ut plurimum enim coloris erat albicantis & cineracei; & in quibusdam lapidi bezoar occidentali consistentia & colore, in aliis vero paucioribus, ut præsertim Fig. 2. lit. *a* & *b*, lapidi bezoar orientali similis; *d*, extremitatis abruptæ; *c*, superficiem exprimit; ut interna lamellata pateat structura.

Præterea & in rene calculus fuit repertus trium drachmarum pondere, qui ex sex sphaëris quasi videtur compositus, ut fig. 4. indicat, substantia cæteris in ventriculo similis ferme. Calculi in ventriculo mulieris cuiusdam reperti, nostro majori multum simile exemplum, exhibet, addita figura, Wilhelmus Clerk, in Transactionibus Philosophicis Anglicanis, No 250.

Aliud exemplum calculi ventriculi vid. in Ephemerid. Nat. Curios. D. 1. Ann. 2. Obs. 181. cum Scholio Philippi Jacobi Sachsi.

J. P. Breynius.

III. *A Letter from the Rev^d Mr. S. Kirkshaw to William Sloane, Esq; F. R. S. concerning Two Pigs of Lead, found near Ripley, with this Inscription on them, IMP. CÆS. DOMITIANO AUG. COS. VII.*

*Ripley near Barrowbridge,
Dec. 15. 1735.*

Hon^d S I R,

I Beg your kind Acceptance of the Inclosed: It is a Draught of One of the Two Picces of Lead, now in the Possession of Sir *John Ingulby*, Bart. of this Place, which were found, in *January* last, on *Hayshaw-Moore*, Two Miles South of *Patley-Bridge*, a small Market-Town in this Neighbourhood, by a Countryman, whose Horse's Foot slipping into a Hole covered with Ling, he dismounted, and, thrusting his Stick into the Hole, perceived something hard, and of the Sound of Metal; and, by digging, found these Two Pieces of Lead, standing upright, and near each other, about Two Foot under-ground. They are of the same Shape and Dimensions, and have the same Inscription. One of them weighs Eleven Stone, the other Eleven Stone and One Pound. The Dimensions I have marked at the End of this Letter; the Draught [TAB. II. Fig. 1.] is as just a one, as any Person I could meet with in the Country, and at this Time of Year, could take. The Inscription is such, as is upon the Leads, to a great Exactness, insomuch that every Irregularity of the Letters is noted: Only it may not be amiss to add, that the Letters are raised, and very bold.

bold. There have been Four other Letters on the Side of each of them, whereabouts I have made the Four Dots in the Draught, but they are grown so obscure, that I cannot discover them with any Certainty.—They seem to have been B. N. I. G. . . . The great *Roman* Causeway leading from *Aldborough*, in this Neighbourhood, into *Lancashire*, passes within a little Way of the Place where the Leads were found. There have been no Lead-Mines, as far as can be known, within some Miles of it: But a Countryman informs me of a large Rock, about half a Mile from it, on the Top of which there is an Impression similar to either of the Leads, only so much larger as to admit of a Pan, wherein they might be smelted, if in so early Time they knew the modern Art of smelting by the Air. As yet, I have not had an Opportunity of viewing this Rock; so that this I have only from Hearsay, though I believe it is credible enough.

These, Sir, are all the Particulars it seems proper to trouble you with concerning these Pieces of Lead. I should only shew my Ignorance and Impertinence, if I did not leave it to the learned and curious Members of your SOCIETY, to determine the Original and Design of them: Only give me Leave to observe, that *Camden* mentions Twenty Pieces of Lead of this kind, found in *Cheeshire*, Part of them with this Inscription, IMP. DOMIT. AUG. GER. DE. CEANG. . . . *Camden's Britan.* Fol. Edit. p. 679.—And more over, that among the Duke of *Parma's* Medals, published by *Paolo Pedrusi*, I do not find any struck in the Seventh Consulate of *Domitian*, but what have the Addition of *Divi Filius*, or the like.—That

Author

Author too says, that the First Year of *Domitian's* being Emperor was the Eighth of his Consulate; neither of which agree with the Inscription on the Leads.—

I am,

Honoured S I R,

Your most obliged,

Obedient Servant,

S. Kirshaw.

The Dimensions of the Piece of Lead, TAB. II. Fig. 1.

From *a* to *b*. ——— 21 Inches.

d to *e*. ——— 23 $\frac{1}{2}$.

a to *c*. ——— 3 $\frac{1}{2}$.

e to *f*. ——— 5 $\frac{1}{2}$.

Perpendicular Depth 4.

IV. *The Description and Draught of a Machine for reducing Fractures of the Thigh, by Mr. Henry Ettrick, Surgeon.*

HAVING frequently considered the many Inconveniences, and great Difficulties, attending the common Methods of Reduction, I determined with myself to attempt a Form more mechanical and certain. I immediately fixed on the Axle and Wheel, as the most simple, and yet fully capable of taking in and ingrossing all and every Advantage necessary towards

towards the well reducing of Fractures, &c. It consists of no more than a Wheel and Pinion, with their Axles; the Roch, or snagged Wheel, being herein accounted as Part of the great Wheel, fixed in a light Frame of about Two Feet long, [see Fig. 2. TAB. II.] the Whole not exceeding the Weight of 15 Pounds; and when taken to Pieces, by unscrewing the Frame-pieces, may be packed up in a common Rush-Basket, belted to the Side, and conveyed to any Distance. Again, the Room it takes up in working is not a full Yard, and may be set up and fixed for Use in a few Minutes. In using this Machine, the Surgeon need but one Assistant; whereas, in most other Methods, their Number is most troublesome and inconvenient: The Business of this Assistant is no farther than to mind the Surgeon's Orders, and move the Winch according to his Direction. When the Extension is sufficient, the Engine stays itself, and continues the Tension of the Limb, by the Assistance of this Roch, or toothed Wheel, whose Teeth are cut fine enough to stay the Engine at every Line of an Inch, and which is fixed on the Back of the aforesaid great Wheel, both to the Cross by the Help of Screws, and on its Arbor by having its Centre squared out, so as to fix tight thereon, and so near the Frame as only to allow a bare clearidge: Its Teeth, standing counter to the former, admit the Spring or Catch fixed on the Inside of the Frame, to slip over the Vertex thereof, without Interruption; but in a reverse Rotation, or when the Engine is about to come up, flies into the Spaces thereof, and stays the same: The upper Part thereof projects about an Inch from the Frame, so that being pressed upon by the Finger of

D d d d

one

one Hand, the inferior Part is elevated above the Range of the Teeth, to admit the coming up of the Engine, which is to be directed by the other Hand being applied to the Winch in any Degree. This Engine has its Power so commanded, that it may be used without Restriction, from the most robust to the most tender Frame, seeing it acts and exerts its Power in proportion to the Resistance made. Farther, as hinted at before, it is enriched with all those Properties which Authors affirm necessary to a successful Operation; for this Extension, according to their Observation, is made deliberately, steady, equally, and in one continued Line, without the least Variation. And further, in oblique Fractures of the Thigh, where the Bones are apt to ride, (and therefore, on that Account, require a continued Extension in a certain Degree, to prevent the Limbs shortening after the Cure) such a Machine must be of excellent Service; having the Property of increasing or decreasing the Extension at Pleasure, and to be perfected without the least Jar or Tremor.

The necessary Appendages are Bands, by which the Engine extends the Limb; and deserve the following Observations: Immediately from the Axle of the great Wheel comes a Girt, at the other End of which Girt is a Hook, which links into a Swivel-Ring at the Bottom of a Sole-plate: This Sole-plate answers the Shape of the Foot, and is made of well-hammered Brass, the Inside of which is padded, to sit easy to the Foot: The upper Part hath a Strop fixed thereto, which clasps over the upper Part of the Metatarsal Bones; and to keep the Stropps ending in the Sole-plate from galling or pressing the Sides of the
Foot

Foot and Ankle, there project Two Arms from the Sides of this Sole-plate, to which the Strops coming from the Ankle-band are fastened. That the whole Limb may be kept in a Line with the Machine, the Leg is suspended by Bands, one of which is placed at the Ankle, from the Sides of which pass Two Strops, to join the inferior Knee-band: From this Band pass Two Strops to the superior Knee-band: All these Strops are designed to divide the Extension, so that all Parts may equally bear alike, and so to secure the Joints of the Limb from the Violence of the Extension. The Inside of these Strops are lined; the Bands incircling the Limb are contrived in the same Manner as the Bow or Spring of a Truss, having strong Clasps at the Ends, after the Manner of those for Pocket-books, to fit any Dimensions. The Band embracing the Part above the Fracture, and from which pass Two Strops to the Head of the Bed, to make the Counter-extension, is of the same kind as the former, and is to be kept on, the whole Time of Decumbiture, to prevent the Patient's Body sinking on the Fracture, and thereby contracting the Limb. The exterior of the Two last-mentioned Strops presses just beneath the great *Trochanter* on its Outside; the other comes from the anterior Part of the same Band, and in such a Scite as to give the Patient Liberty to raise himself at Discretion. To preserve the natural Curvity of the Thigh, it would be necessary to have a large broad Band arising from the Bedside, to encompass the fractured Part, and keep it steady.

Explanation of Figure 2. TAB. II.

- A. A. *Represents the Bed.*
- B. *The Patient.*
- C. *The Machine at the Feet of the Bed.*
- D. D. *The Frame.*
- E. *The great Wheel.*
- F. *The Rock-wheel, with a Catch and Spring,
to prevent the Wheel going back.*
- G. *The Pinion.*
- H. *The Winch.*
- I. *The Arbor of the great Wheel, whereon*
- K. *the Girt K is fixed: The Diameter of the
Barrel thereon is Two Inches.*
- L. *The End of the Girt fixed by*
- M. *the Ring M. to*
- N. *the Sole-board N.*
- O. *The Band which passes over the Instep.*
- P. *The Ankle-band.*
- Q. *The Strop which passes from the Sole-plate
to the Ankle.*
- R. *The Strop continued from the Ankle to the
Knee.*
- S. *The Knee-band.*
- T. *The superior Knee-band, with the Strop con-
tinued, as before.*
- V. *The Band embracing the Part above the
Fracture.*
- W. W. *The Counter-strops passing to the Bed's-
head.*
- X. *The lateral Band to preserve the Curvity
of the Thigh-bone.*

P. S. I thought it would not be improper, if I should attempt to demonstrate to what great Exactness Machines of this Nature may be made to operate.

A Specimen of which I beg Leave to present as follows: Admit the Barrel 4 Inches Diameter, the Roch-wheel to be cut with 48 Teeth, the great Wheel to have 32, answerable to a Pinion with 8. The Reason of pitching on a Barrel of this Dimension is, that it may be more precisely judged what Extension has been made; for repeated Revolutions of the Girt upon the Cylinder, in extending, would, by its uncertain Increase, subject the Judgment to err; whereas the utmost Extension required comes within one Revolution of this Barrel. The Teeth of the Roch to be numbered at every Fourth, which will be at every Inch, and equals in one Revolution the Periphery of the Barrel; consequently every Tooth of this Roch will stretch the Limb One-fourth of an Inch: So though the Spring or Catch to the said Roch should pass the capital Numbers, and stop in the Interspaces thereof, it is only counting from the last capital Number to the Place where the Spring is, and that gives the Parts of the Inch: By the same Rule the Winch, every Turn it makes, will gain a Fourth of this Wheel, which will be 3 Inches, or 12 Teeth; and 4 Revolutions thereof will answer to the Periphery of the Barrel: So by measuring the sound Limb, and comparing the fractured therewith, the Extension required may be nearly demonstrated. With the Use of this Machine, I should recommend the 18 Tail Bandage to the circular Rollers of *Hippocrates*, since they are both less troublesome to the

the Surgeon, and less painful to the Patient; nor yet so liable to wreath the Muscles, and distort the Ends of the fractured Bones.

And to render this Machine of the like Service at Sea, where we are in the greatest need of Helps of this Nature; I have designed a Bed to swing and yield to the Ship's Motion, whereon the Patient is to be laid, with the Engine thereto fixed, that the frequent Discomposure and Disturbance given to the fractured Part by the Ship's rolling and working at Sea, may be prevented.

V. *De Ostreis Petrefactis Relatio* Cornelii le Bruyn, *Illustrata per* Jac. Theodor. Klein, *R. S. S. Reip. Gedan. a Secret.*

INdefessus peregrinator Cornelius le Bruyn * inter alia ad historiam naturalem notatu digna, pag. 480. *seq.* ostrea exhibet, quorum non solum valvas petrefactas, sed & animal ipsum intra conchas in lapidem mutatum offendit.

Prima facie & narratio & figuræ, quas dedit, suspectæ videbantur, magisque fidenter quam vere traditæ. Audiamus auctorem :

“ A quelque milles de Nicosie il y a une petite
 “ montagne, qui n'est que d'huitres petrifiées — les
 “ ecailles en sont ferrées l'une contre l'autre, et, lorsqu'on les ouvre, on voit l'huitre des deux cotés des

* *Voyage, Tome Second, à Paris & Rouen 1725. 4°.*

“ ecailles, si bien consumée, qu’on diroit, qu’elle y est
 “ gravée. Ces ecailles sont aussi pétrifiées, ou chan-
 “ gées en pierre — J’en ouvris une — au milieu de
 “ laquelle on voit l’huitre toute entière, &, en
 “ même tems, comment elle paroît gravée dans
 “ l’autre ecaille.”

Non admirabar testas in lapidem versas, sed ostreum animal petrefactum mirum audiebat; nec sufficere videbatur ratio hujus phænomeni, quam auctor probabilem ratus est, verbis:

“ Quand on ôte le sable de la première ecaille,
 “ on voit l’huitre, qui est de même consumée par le
 “ tems, d’où il faut conclure, que ces huitres y ont
 “ été vivantes, & que l’eau s’étant écoulée, le sable
 “ a insensiblement pris la place, & que l’huitre en
 “ mourant a imprimé la forme dans l’ecaille — Ainsi
 “ il en est de ces huitres, comme de ces pierres, ou
 “ l’on voit un poisson.”

Vix enim intelliges, quid sibi velit moribundi ostrei (animalis mollis, facile corruptibilis) FORMA testis suis ante impressa, quam ipsæ testæ (natura duræ) abierunt in lapidem; neque statim ibis in sententiam auctoris: Quod non superet possibilitatem, ut ostreum sui figuram imprimeret testis pari modo, quo sceleta piscium SCHEMATA sua relinquunt post se in materia terrea subacta, quæ postmodo vertitur in lapidem plerumque scissilem.

Iraque operæ pretium esse duxi, hanc relationem ad captum accommodare, & in clariore luce exponere schematibus LITHOSTREI, quod integrum ex lapide durissimo montis Zigarorum (*Zijanken-Berg*) prope Gedanum anno 1736. feliciter excussi.

In antecessum autem monendum, 1. Lapidēs Gedanenses figuratos, varia multaque insolita ex regnis vel animali vel vegetabili continentes, inprimis montium, qui a grandine (*Hagels-Berg*) & a Zigaris nuncupantur, ac vicinorum, ex argilla & luto cum tantillo arenæ mixtis esse fictos, cinerei coloris, plerumque durissimos, adeo ut tudite ferreo cæsi ad instar vitri fossilis *Imperati*, sive lapidis cornei vulgatissimi, subnigri, i. e. culinaris, dissiliant. 2. Quod præ reliquis ostracomorphitæ testas sive cochlidum sive concharum foveant sapissime integras, petrefactas quidem, coloribus naturalibus tamen plerumque & optime distinguendas; aliquando, ubi matrix (quæ vulgo audit) minus compacta vel dura est, partim quasi calcinatas, partim in lapidem versas.

Jam in præfacto lithostreo, nisi fallor, sese manifestabunt phænomena, quæ celebris Cornélius le Bruyn in relatione sua, licet obscura, fortasse nobis exponere voluit; in quem finem,

Hujus lithostrei partes, valvis ejusdem circumspēcte reclusis, exacte ac vivis coloribus pingi curavi, TAB. III.

Fig. 1. exhibet testam inferiorem complanatam, tenaciter in lapide durissimo hærentem, ex genere ostreorum saxatiliū; de quibus vid. *Lister. de Cochl. Tit. xxvii. p. 182.* cardine utrinque canaliculato, vel ginglymis

a, a, instructo.

b, Manifestum vestigium validi tendinis, quo mediante animalculum valvas & ad plausum aperit & claudit.

c..c, Branchias suspicatus sum (vulgo barbā) ostrei; colore ex cinereo albicante, & sua substantia lævissima a colore & materia
la-

lapidis sese distinguentes, coadunatis scilicet particulis resolutis branchialibus cum terreis particulis subtilissimis, & successu temporis petrificantibus, quasi in magmate superstites; idque eo fidentius credidi, quo facilius branchiæ testaceorum naturales pariter a reliquis partibus mollibus colore & substantia distinguuntur.

Fig. 2. Superior valva est, vel concha magis convexo-concava, quam superior valva ostrei in coenis noti; ubi rursus

a, a, Ginglymi, &

b, Tendo, antagonista, apparent.

Fig. 3. Prototypum dixeris animalculi, post branchias integri, pariter ac branchiæ immutatum, & in cavitate valvarum repertum; in quo litera

• *a,* cernere licet vestigium processus tendinosi a parte testæ convexo-concavæ:

b, vero processum valvæ complanatæ oppositum.

Sic salva mansit forma animalis, tota vero substantia abiit in materiam lutosam, indurata, lævem;

Et id forsitan est, quod Le Bruyn dicere voluit, verbis;
 “ Au milieu . . . on voit l’huitre entiere, et en
 “ même tems, comment elle paroît gravée dans
 “ l’autre écaille.”

Fig. 4. Reliquum diconchæ; ex quo apparet, testam fuisse minus ponderosam testa ostrei vulgaris; lævem; non imbricatam neque sulcatam.

Cæterum omnibus notum est, quod in plurimorum ostreorum interna, inprimis concavæ valvæ pariete, sit velut cisterna, aquam cum voluptate appeti solitam continens, tenui lamella testacea clausa, & a car-

dine plerumque integrum animalis thalamum adæquans; hanc cisternam, cum a solida testa mox distinguitur, imperitos fallere, experientia me docuit. Nam plus una vice contigit, quod hic vel ille in conchis fossilibus cavitatem transparenti laminula opertam imaginarie pronuntiaverit; ostrei figuram testæ alterutri ruditer inscriptam.

Forſan vel ſimilis teſta fossilis monticuli Nicofiani Bruynio impoſuit, “ Que l’huitre a imprimé ſa forme “ dans l’écaille,” audacter ad figuram, quam dedit, provocanti; “ comme on le peut voir dans la figure;” cum tamen ipſa figura, paulo attentius conſiderata, nihil aliud oculis offert, quam ſimplicem teſtam, vix umbratilem, difformem potius vel imaginariam oſtrei ſpeciem formamve mentientem. Hoc aſſertum multis ſchematicis probare poſſem, ſed unicum ſufficiat:

Fig 5. Oſtrei peregrini & polyginglymi, montis Zigarorum. Ecquis autem nobis perſuadere præſumeret, circumſcriptam literis *a*; *b*; *c*; *d*; *e*; figuram eſſe formam, quam animal moribundum teſtæ ſuæ impreſſit? cum in oculos incurrat, denotare cisternam ſuprafatam, non niſi particula dictæ lamellæ teſtaceæ tenuis, e regione literæ *b*, ſuperſtite.

VI. *Observationes Martis, Autumno Anni 1736.*
Berolini habitæ, a Christfr. Kirch, Regiæ
Societatis ibidem Astronomo.

I.

Conjunctio Martis & μ κ .

I. Diebus 10, 11 & 12 Octobris, cum δ prope μ κ , stellam 5 magnitudinis transiret, sequentes observari distantias centri Martis a dicta stella.

Stylo novo.	Temp. vero.			Partes Microsc.	Veloc. Microsc.
	H. /				"
D. 10 Octobr.	9. 41. vesp 9. 46.	δ μ κ . . .	Tub. 7 ped. Tub. 9 ped.	15 22	13 24 6 33
D. 11 Octobr.	10. 1. 10. 4. 10. 9. 10. 12.	δ μ κ	Tub. 9 ped. Tub. 7 ped. Tub. 7 ped. Tub. 9 ped.	22 $\frac{1}{2}$ 16 16 $\frac{1}{2}$ 22	6 33 6 33 6 33 6 33
D. 12 Octobr.	8. 55. vesp. 8. 59. 9. 5.	δ μ κ	Tub. 9 ped. Tub. 7 ped. Tub. 7 ped.	71 $\frac{1}{2}$ 53 53 $\frac{1}{2}$	21. 18. 21. 12. 21. 24.

II. Ut ex his distantiis observatis eruerem Tempus conjunctionis Martis cum stella μ κ , elegi 3 distantias sequentes.

	H. /		"	"
1. D. 10. Octobr.	9. 43. vesp. dist. cen- tri δ a μ κ	} 19. 22.		
2. D. 11. Octobr.	10. 6. vesp. . . .	} 6. 34.		
3. D. 12. Octobr.	9. 0. vesp. . . .	} 21. 18.		
	E e e e 2	Et		

Et ex ephemeridibus supposui motum diurnum Martis in longitudine $19^{\circ} 30''$, in latitudine $3^{\circ} 40''$: est itaque motus diurnus Martis in orbita propria $19^{\circ} 51''$, & angulus orbitæ Martis & eclipticæ (seu potius cum parallelo eclipticæ) $10^{\circ} 39'$.

III. Datis in triangulo obliquangulo $a\mu b$, tribus lateribus, [vid. Fig. I. TAB. IV.] scilicet

ab , motu Martis, qui competit $24^h. 23'$. (scilicet tempori inter observationem 1 & 2) . . . $20^{\circ} 10''$.

$a\mu$, distantia primo observata . . . $19 \quad 22$.

$b\mu$, distantia secundo observata . . . $6 \quad 34$.

Duxi $a\mu$ perpendicularem in orbitam Martis apparentem $\mu\chi$, & in triangulo rectangulo $b\chi\mu$ quæsi partem orbitæ Martis, $b\chi$, eamque inveni $1^{\circ} 51''$.

& distantiam minimam $\delta\&\mu, \chi\mu$, quam inveni $6 \quad 18$.

Particulæ orbitæ Martis, χb , competunt $2^h. 14'$

Quæ subtracta a tempore 2 observationis D. 11. Octobr. . . . } $10 \quad 6$. vesp.

Relinquit temp. ver. $\delta\&\mu\&$ in orbita D. 11. Octobr. . . . } $7 \quad 52$. vesp.

IV. In triangulo obliquangulo $b\mu c$, motus Martis inter 2 & 3 observationem, $b c$, est . . . $18^{\circ} 55''$.

Distantia $\delta a\mu\&$ secundo observata, $b\mu$. . . $6 \quad 34$.

Distantia $\delta a\mu\&$ tertio observata, $c\mu$. . . $21 \quad 18$.

Datis his tribus lateribus quæsi angulum c , eumque inveni $17^{\circ} 35'$. Deinde duxi perpendicularem $a\mu$ in orbitam Martis, $\mu\chi$, & in triangulo rectangulo $c\chi\mu$; data hypotenusâ $c\mu$, quæsi latera $\mu\chi$, & $c\chi$, & inveni $\mu\chi$, distantiam minimam $6^{\circ} 26''$, & $c\chi$, $20^{\circ} 18''$.

A quo subtractum latus $b c$ $18 \quad 55$.

Relinquit $b\chi$ $1 \quad 23$.

Cui

Cui competunt in tempore . . . 1h. 40'.

Quæ subtracta a tempore 2 observa- } 10 6. vesp.
tionis 11 Octobr.

Dant tempus verum distantiae minimæ, }
five conjunctionis Martis & $\mu\chi$ } 8 26. vesp.
in orbita 11 Octobr.

V. Deducta in his duobus proxime antecedentibus paragraphis, ut fieri solet, paululum inter se differunt. Si motum Martis diurnum quadrante circiter minuti minorem assumssem, discrepantia foret minor. Interim, si ex deductionibus utrisque medium eligo, a veritate vix aut parum aberrare potero. Et sic colligitur *tempus verum* & $\delta\mu\chi$ in orbita Martis, 11 Oct. 8h. 9'. *distantia minima* & a $\mu\chi$ 6' 22''. *Septentrionalis*.

VI. Quamvis hæc sufficere mihi potuissent, tamen de novo calculum institui, supponens motum δ diurnum in longitudine 19' 15''.
in latitudine 3 40.

Fuit itaque motus δ diurnus in orbita . . . 19 36.
Et angulus orbitæ Martis cum parallelo eclipticæ 10° 47' intervalla temporum inter observationem 1 & 2, & inter 2 & 3, dato hoc motu Martis diurno in orbita 19' 36'', dant ab 19' 55'', & bc 18' 42''; distantiae $a\mu$, $b\mu$, & $c\mu$, manent eadem, quæ in superioribus calculis. His datis primo per triangulum $ab\mu$, inveni $\mu\chi$ 6' 22'', & $b\chi$ 1' 37'' $\frac{1}{2}$.

Quibus respondent 1h. 59'.

quæ subtracta a D. 11 Octobr. 10 6. vesp.

Relinquunt tempus distantiae minimæ } 8 7. vesp.
D. 11 Octobr.

Deinde per triangulum $bc\mu$, inveni $\mu\chi$ 6' 21''.
Et

Et $b\chi$ $1' 38''$, quibus respondent in } 2h. 0'.
 tempore }
 Quæ subtracta a temp. 2 observa- } 10 6. vesp.
 tionis D. 11 Octobr. }
 Relinquunt tempus distantiae minimæ } 8 6. vesp.
 D. 11 Octobr. }

Ut itaque hi calculi optime inter se, & cum supra electo medio priorum calculorum, conveniant.

VII. Si ex μ ducitur linea recta μd , quæ cum linea $\chi\mu$, perpendiculari in orbitam Martis, ad μ faciat angulum æqualem angulo orbitæ Martis cum parallelo eclipticæ, $d\mu$ erit perpendicularis in eclipticam. Hunc angulum primo deduxi $10^\circ 39'$ (§. II.) deinde mutato sive correcto motu diurno Martis, eum inveni $10^\circ 47'$ (§. VI.) In triangulo rectangulo $d\chi\mu$, jam præter angulos notum est latus $\chi\mu$ $6' 22''$, & reliqua latera quærentur. Assumpto angulo $\chi\mu d$, $10^\circ 39'$ latus χd eruitur $1' 12''$. Si vero correctiorem angulum adhibeo $10^\circ 47'$, illud latus χd erit $1' 13''$.

Cui competunt in tempore 1h. 29'.
 Quæ addita ad tempus distantiae minimæ } 8 7.
 11 Octobr. }
 dant tempus verum $\delta \delta \& \mu \times$ in } 9 36.
 ecliptica 11 Octobr. }

$d\mu$, sive differentia latitudinis Martis a latitudine stellæ in δ in ecliptica, eruitur . . . 6' 29''.

Quæ subtracta a latitudine stellæ .. $3^\circ 4 25$. Mer.

Relinquit *Latitudinem Martis* . . 2 57 56. Mer.

Longitudo Martis est æqualis longitudini stellæ, scilicet ex accuratissimo *stellarum inerrantium catalogo Britannico* γ . $19^\circ 25' 40''$.

VIII. Ad tempus conjunctionis Martis & μ κ in ecliptica, scilicet Berolini, tem. vero. 11 Oct. 9^h. 36".

Et Bononiæ tempore medio . . . 11 Oct. 9 14.

Ex ephemeridibus Cel. Manfredii }
eruitur longitudo Martis . . . } r. 19° 14' 40".

Quæ deficit ab observatione 11 0.

Ephemerides Ghislerii dant longit. δ r. 19° 4' —

22 fere minutis ab observatione defi- }
cientem, & ephemer. Dni. Desplaces } r. 19 25 —

Observationi satis congruam.

Manfredianæ ephemerides dant latitudinem Martis meridionalem 2° 57'. —

Id est; 1 minuto fere minorem latitudine observata; ex ephemeridibus Ghislerianis illa colligitur . 2° 57' $\frac{1}{2}$.

& ex Desplaces ephemeribus 2 59 $\frac{1}{2}$.

II.

Locus Martis in oppositione Solis.

I. Tempore conjunctionis Martis & μ κ in ecliptica, ex Manfredianis ephemeribus eruitur locus Solis 6 = 18° 46' 21".

Quo tempore longitudo Martis fuit 0 r. 19 25 40.

Itaque δ fere fuit in oppositione Solis, & tantum 39' 19". abfuit a loco Soli opposito.

Motus diurnus Solis fuit 0° 59' 34".

Et Martis retrogradî motus diurn. in eclipt. 19 15.

Summa dat motum \odot a δ diurnum . 1 18 49.

II. Ut 1° 18' 49". motus diurnus \odot a δ , ad 24 horas, ita 39' 19" distantia δ ab opposito Solis ad 11^h 58'.

Quæ addita ad tempus verum δ δ μ κ in }
eclipticâ 11 Octobr. } 9 36.

Dant.

Dant *tempus oppositionis Martis & Solis* } 21^h 34'.
Berolini, tempore vero 11 Oct. . }

Æquatio temporis subtrahatur . . . 13^h ½.

Et restabit tempus medium Berolini 11 Oct. 21 20^h ½.

Pro differentia meridianorum inter Bononiam & Berolinum subtrahere . } 8^h ½.

Restat tempus medium Bononiæ 11 Oct. 21 12.

III. Ut 24 horæ ad 19' 15'' motum diurnum Martis in longitudine, ita 11^h. 58'. tempus inter δ δ & μ \times in ecliptica & oppositionem \odot & δ , ad 0° 9' 36''.

Quæ subtracta a Long. δ in δ δ & μ \times 0 γ 19 25 40.

Relinquant *Longitud.* δ in δ \odot . . 0 γ 19 16 4.

Locus Solis ex ephemeridibus Manfredianis

D. 11. Oct. 21^h. 12'. tempus medium Bononiæ eruitur . . } 6 \approx 19 16 3.

Differentia tantum unius minuti secundi (præter semicirculum) a loco Martis, quæ tuto negligitur.

VI. Ut 24 horæ ad 3' 40'', motum diurnum Martis in latitudine, ita 11^h. 58' ad . 0° 1' 50''.

Quæ subtracta a Latitudine Martis

In conjunctione δ & μ \times in ecliptica 2 57 56 Mer.

Relinquant *Latitudinem* δ in δ \odot 2 56 6 Mer.

III.

Observationes Martis circa stationem ejus secundam, mense Novembri, ann. 1736.

Verfabatur Mars inter stellas ϵ , ϵ & ζ Piscium, aliasque stellas minores; a quibus distantias Martis sæpius dimensus sum, tribus diversis tubis, scilicet tubo 7, tubo 9, & tubo 2 pedum, semel etiam tubo 18 pedum. Per tubos longiores distantiae accuratiores capi possunt: quia vero spatium non adeo magnum simul comprehendunt, minores tantum distantias per ipsos

ipſos dimetiri potui. Per tubum 2 pedum majores quidem diſtantiæ obſervari potuerunt; illæ tamen non adeo accuratæ eſſe ſolent, quin aliquando dubium 1 vel 2 minutorum irrepere poſſit, præſertim ſi diſtantiæ nimis magnæ ſunt, ut capacitatem tubi fere expleant. Tales errores maxime ſe produnt, quando ſitus ſtellarum in chartam delineatur, & diſtantiæ planetæ a diverſis ſtellis, non in uno puncto, ſe interſecant. Excerpti ſtellas, a quibus Martem diſenſus ſum, ex catalogo Britannico, & per diſtantias Martis ab his ſtellis, locum planetæ ope circini indagavi. Primo enarrabo diſtantias captas; deinde exhibebo loca Martis per illas eruta. Ubi notandum eſt, me delineatione uſum fuiſſe, in qua magnitudines graduum, & diſtantiæ ſtellarum, duplæ fuerunt earum, quaſchema adjectum exhibet. [Vid. Fig. 2. TAB. IV.]

Stylo novo.	Temp. vero velperi.			Partes Microm.	Valor parium Microm.
	H.				o. / . "
D. 27 Oct.	8. 58.	♂ e ☿	Tub. 7 ped.	121.	o. 48. 24.
D. 29 Oct.	8. 30	♂ e ☿	Tub. 7 ped.	6.	24. 48.
	8. 38.	. . .	Tub. 9 ped.	83.	24. 43.
D. 1 Nov.	11. 6.	♂ e ☿	Tub. 9 ped.	38.	11. 18.
	11. 10.	. . .	Tub. 7 ped.	28.	11. 12.
D. 5 Nov.	7. 22.	♂ a.	Tub. 7 ped.	34 $\frac{1}{2}$.	13. 48.
	7. 26.	♂ e ☿	. . .	100 $\frac{1}{2}$.	40. 12.
	8. 14.	♂ c.	. . .	105.	42. 0.
	8. 21.	♂ a.	Tub. 9 ped.	44.	13. 6.
D. 6 Nov.	7. 28.	♂ a.	Tub. 7 ped.	17.	6. 48.
	7. 34.	♂ e ☿	. . .	116.	46. 24.
	7. 40.	♂ c.	. . .	110.	44. 0.
		vel.		110 $\frac{1}{2}$.	44. 12.
	7. 44.	♂ a	Tub. 9 ped.	23 $\frac{1}{2}$.	6. 59.

Stylo novo.	Temp. vero vesperi.			Partes Micro.	Valor partium Microm.
	H.				° / ' "
D. 7 Nov.	6. 4.	♂ a.	Tub. 18 ped	16.	2. 17.
	7. 47.	♂ a diffic.	Tub. 7 ped	5½.	2. 12.
	7. 50.	♂ e ☿	. . .	129.	51. 36.
	7. 53.	♂ c.	. . .	118.	47. 12.
D. 12 Nov.	9. 19.	♂ a.	Tub. 7 ped	52.	0. 20. 48.
	9. 27.	♂ e ☿	. . .	172.	1. 8. 48.
	9. 38.	♂ c.	. . .	165.	1. 6. 0.
D. 13 Nov.	7. 32.	♂ a.	Tub. 9 ped.	77.	0. 22. 56.
	7. 36.	♂ a.	Tub. 7 ped.	58.	0. 23. 12.
	7. 40.	♂ e ☿	. . .	175.	1. 10. 0.
	7. 44.	♂ c.	. . .	171.	1. 8. 24.
D. 15 Nov.	7. 2.	♂ a.	Tub. 7 ped.	72.	0. 28. 48.
	7. 9.	♂ e ☿	. . .	179.	1. 11. 36.
	7. 13.	♂ c.	. . .	186½.	1. 14. 36.
	7. 18.	♂ a.	Tub. 9 ped	95.	0. 28. 35.
D. 26 Nov.	6. 11.	♂ e ☿	Tub. 2 ped.	91.	1. 22. 6.
		♂ ☿	. . .	106.	1. 35. 38.
		♂ e ☿	. . .	94.	1. 24. 48.
		♂ c.	. . .	143.	2. 9. 2.
		♂ a.	. . . ☿	113.	1. 41. 57.
		♂ e ☿	. . .	92.	1. 23. 0.
		♂ a.	. . .	103.	1. 32. 55.
	6. 32.	♂ a.	. . .		
	D. 28 Nov.	6. 43.	Tub. 2 ped.	104.	1. 33. 50.
		6. 46.	. . .	82.	1. 13. 59.
		9. 34.	. . .	103.	1. 32. 55.
		9. 37.	. . .	105.	1. 34. 44.
		9. 41.	. . .	82.	1. 13. 59.
D. 3. Dec.	9. 41.	♂ e ☿	Tub. 2 ped.	160.	2. 24. 23.
		♂ e ☿	. . .	157.	2. 21. 40.
	9. 52.	♂ ☿	Tub. 7 ped.	56.	0. 22. 24.
	10. 1.	♂ ☿	Tub. 9 ped.	75½.	22. 29.
D. 6. Dec.	5. 33.	♂ e ☿	Tub. 2 ped.	201.	3. 1. 22.
		♂ e ☿	. . .	204.	3. 4. 4.
		5. 44.	. . .	50.	0. 45. 8.
		♂ ☿	Tub. 7 ped.	113½.	0. 45. 24.
	5. 57.	♂ ☿	Tub. 9 ped.	153.	0. 45. 34.

Hæ distantiaæ semper a centro Martis intelligendæ sunt, præsertim per tubos longiores.

Sequuntur loca Martis, ex distantiiis recensitis deducta, & loca ejusdem ex diversis ephemeridibus excerpta, ut consensus sive dissensus appareat inter calculos & observationem.

Stylo novo.	T. ver. vesperi.		Longitudo Martis.	Latitudo Martis.
	H. '.		° ' "	° ' "
D. 5 Nov.	8. 18.	Observatio Manfredii. Ghislerii. Desplaces.	♄ 13. 37. 0 13. 26. — 13. 42. — 13. 35. 30	1. 17. 0. M. 1. 16. 30. 1. 20. 30. 1. 17. 30.
D. 6 Nov.	7. 26.	Observatio Manfredii. Ghislerii. Desplaces.	♄ 13. 32. 0. 13. 22. — 13. 37. 30. 13. 31. —	1. 13. 15. M. 1. 13. — 1. 16. — 1. 14. —
D. 7 Nov.	7. 50.	Observatio Manfredii. Ghislerii. Desplaces.	♄ 13. 27. 40 13. 17. 40 13. 32. 40. 13. 27. —	1. 9. 30 M. 1. 9. 20. 1. 12. — 1. 10. —
D. 12 Nov.	9. 28.	Observatio Manfredii. Ghislerii. Desplaces.	♄ 13. 20. 0. 13. 8. — 13. 19. 30. 13. 18. —	0. 50. 40. M. 0. 51. — 0. 53 — 0. 51 30.
D. 13 Nov.	7. 38	Observatio Manfredii. Ghislerii. Desplaces.	♄ 13. 20. 30 13. 9. 15 13. 19. — 13. 19. —	0. 48. 0. M. 0. 48. — 0. 49. 30. 0. 48. —
D. 15 Nov.	7. 12.	Observatio Manfredii. Ghislerii. Desplaces.	♄ 13. 23. 30. 13. 13. — 13. 21. 30 13. 21. 30.	0. 42. 0. M. 0. 41. — 0. 43. — 0. 41. —
D. 26 Nov.	6. 20.	Observatio Manfredii. Ghislerii. Desplaces.	♄ 14. 35. 0 14. 26. — 14. 37. — 14. 34. —	0. 9. 0. M. 0. 9. — 0. 12. — 0. 9. 30. M.

Stylo novo.	T. ver. vesperi.		Longitudo Martis.	Latitudo Martis.
	H. '.		° ' "	° ' "
D. 28 Nov.	9. 35.	Observatio Manfredii. Ghislerii. Desplaces.	Υ 14. 57. 0. 14. 49. 30. 14. 59. — 14. 57. 30.	0. 3. 30. M. 0. 4. — M. 0. 7. — M. 0. 5. — M.
D. 3 Dec.	9. 48.	Observatio Manfredii. Ghislerii. Desplaces.	Υ 16. 1. 0. 15. 57. — 16. 3. — 16. 2. —	0. 6. 30. S. 0. 7. 40. S. 0. 5. — S. 0. 7. — S.
D. 6 Dec.	5. 46.	Observatio Manfredii. Ghislerii. Desplaces.	Υ 16. 46. — 16. 40. 30. 16. 47. 30. 16. 50. 33.	0. 16. — S. 3. 13. 30. 0. 10. 30. 0. 13. 30. S.

Duobus ultimis diebus, scilicet 3. & præsertim 6 Decembris, loca Martis, ex observatione deducta, sunt incerta: Illa itaque, si cui ita visum fuerit, plane omitti possunt.

Loca stellarum fixarum in schemate adjecto, ex catalogo Britannico ad initium anni 1690. sine ulla reductione excerpta sunt: quare longitudinibus Martis, quas figura nobis exhibuit, 39' 0'', vel 39' 5'', addenda fuerunt, pro motu stellarum fixarum in 46 annis, & 10 vel 11 circiter mensibus.

Omissæ sunt supra observationes diei 9 Novembr. quas hic adjiciam, cum loco Martis ex illis deducto.

Stylo novo.	Temp. vero vesperi.			Partes Micro.	Valor par- tium Mi- crom.
	H. '.				
D. 9 Nov.	9. 28.	♂ a.	Tub. 7 ped.	25.	0. 10. 0.
	9. 30.	♂ e X	. . .	152.	1. 0. 48.
	9. 34.	♂ c.	. . .	136.	0. 54. 24.
	9. 41.	♂ a.	Tub. 9 ped.	32½.	0. 9. 40.

Stylo

Stylo novo.	Temp. vero vespere.		Longitudo Martis.	Latitudo Martis.
			° ' "	° ' "
D. 9 Nov.	9. 34.	Observatio	13. 22. 20.	1. 1. 30. M.
		Manfredii.	13. 22. —	1. 0. 30.
		Ghislerii.	13. 11. —	1. 3. 30.
		Desplaces.	13. 25. —	1. 2. 30.

VII. *A Collection of the Observations of the Remarkable Red Lights seen in the Air on Dec. 5. 1737. sent from different Places to the ROYAL SOCIETY.*

1. *An Account of the Red Lights, on Dec. $\frac{5}{16}$. 1737. as observed (at Naples) by the Prince of Cassano, F. R. S. and by him sent in a Letter to the President: Translated from the Italian by T. S. M. D. F. R. S.*

A *Phænomenon* of a fiery Meteor is my Motive for troubling you, Sir, with this other short Narrative; being persuaded that it will be as agreeable to you to peruse, as it was to me to draw it up with all the Circumstances of Truth, to which I was an Eye-witness.

Dec. 16. 1737. (*N. S.*) in the Evening, the Sun being about 25 Degrees below the Horizon, a Light was observed in the North, as if the Air was on Fire, and flashing; the Intensity of which gradually increasing, at the Third Hour of the Night it spread Westward in such a Manner, that if a Perpendicular was let fall from the Polar Star, and afterwards a

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Parallel to the Horizon supposed, and divided into Six equal Parts, which Parallel should pass through the whole Extent of the aforesaid Light, it is certain, that Five Parts of the Six would be towards the West, and only One toward the East.

The greatest Height of this Light was about 65 Degrees; for it occupied the whole Extent of both the *Bears*, and the *Polar Star*: Yet at the Sides it was not so high; for in some Places near the North it arose only to 50 Degrees; and gradually diminished, so as to become insensible at the true Horizon.

The above-mentioned Light at its Extremities was unequally jagged, and scattered, and followed the Course of the Westerly Wind; so that for a few Hours it spread considerably wider, yet without ever reaching the *Zenith*.

The greatest Redness and Inflammation appeared half Way, between the visible Pole and the Northern Point of the Horizon; and in the Middle of this inflamed Part there appeared some Streaks less inflamed, and mostly perpendicular to the Horizon; some of which flashed from time to time, while others successively vanished. About the Sixth Hour of the Night the Intensity of the Colour disappeared; some small Traces of the Inflammation still remaining towards the North-east and the West, which were all vanished at $7^h. \frac{1}{2}$ [of the Night.]

During the greatest Vigour of the Inflammation, some small dark Clouds often crossed the Light parallel to the Horizon: But the Sky was very clear, except in some Parts near the Horizon, where it was much overcast with Clouds.

The inflamed Matter, in the greatest Part of its Extent, gave a free Passage to the Rays of the Stars, even of the Third and Fourth Magnitude, situate behind it. About the Fourth Hour of the Night, a very regular Arch of a parabolic Figure was seen to rise gently, to Two Degrees of rectangular Elevation, and to Twenty Degrees of horizontal Amplitude.

This *Phænomenon* was seen all over *Italy*, as appears by several Accounts of it, though with some Disagreement between them.

But how bright soever and distinct it appeared, yet its Cause has been deemed by many to be very obscure: For some call it an *Aurora Borealis*, therein following the Opinion of *Gassendus*, and deducing all the Appearances from the Laws of simple Refraction of the solar Rays. Others think it an Irradiation of some luminous Comet, placed below our Horizon. Others more politely say, it was a new celestial Body descended from its upper Habitation down to us, and courteously received by the Earth's *Vertex*. Others, in Love with Authority, and *French* Names, have endeavoured to establish the Meteor as a Mixture of the Two Atmospheres of the Sun and Earth; therein tenaciously adhering to the new Opinion of Monsieur *de Mairan*, of the *Academy of Sciences* at *Paris*. In fine, others more accurately deduce the Whole from the simple Firing of a bituminous and sulphureous Matter, upon account of its very little specific Gravity, raised to the upper Parts of the Atmosphere, and there, by the Clashing of contrary Winds, broken, comminuted, and at last set on Fire. This Opinion has been defended with strong Arguments, in the *Petersburg Commentaries*,
by

by *Mayerus*, upon Occasion of the Appearance of a similar *Phænomenon* in those Northern Countries.

And, indeed, the preceding Eruption of *Vesuvius*, the Contrariety of the moving Forces, the Readiness of the Matter to take Fire, the unequal Intensity of the Light, the Streaks, and all the other Circumstances, observed in this Meteor, are plain Arguments of a genuine and real Accension. And *Wolffius*, on the Appearance of a *Phænomenon* much like this, which was seen all over *Germany* on the 17th of *March* 1717. is of Opinion, that it should be called imperfect Lightning, as being produced by the inflammable Matter of Lightning: And possibly we shall see the subsequent Rains fall quietly, without Lightning or Thunder.

1st, That it could be a Refraction, happens to be diametrically contrary to the Laws of Refraction; because the Sun was then in the opposite Tropic.

2^{dly}, The Light ought to have been most intense in the East, and weak in its Elevation; whereas quite the contrary was seen to happen. Thus the Whole is accounted for, not by Dioptrics, but by the sole Laws of direct or reflex Vision; and the Streaks, already taken notice of, were Spaces containing less of the inflammable Matter; whereby the luminous Rays of the neighbouring kindled Matter, being weakly reflected, made the Appearance of a fainter Colour.

3^{dly}, The uneven Appearance of the Light at its Extremities cannot be accounted for by Refraction, but perfectly well by Accension: Wherefore I think it rather deserves the Name of a *Northern Light* or *Fire*, than that of an *Aurora*: But I leave the further Consideration thereof to better Heads.

2. *An Account of an Aurora Borealis observed in the Night of the 16th of December 1737. (N. S.) at Padua, by [the Marquis] Poleni, F. R. S. Communicated in a Letter to Dr. Jurin: Translated from the Latin by T. S. M. D. F. R. S.*

THE Sky was intirely clear, not only in the Beginning, but during the whole Night. The Wind was at North; which was rather known by the Weather-cock, than sensibly felt, the Air being very still. The Quicksilver in the Barometer stood at 30 Dig. 24 Dec. (*English Measure*) an extraordinary Height; since in the Space of 14 Years, that I have applied with great Care to Meteorological Observations, I have but once observed the Quicksilver at 30. 48. which I have hitherto looked upon as the greatest Height.

In my Thermometer of Monsieur *Amonton's* Make, the Height of the Quicksilver was 48 Dig. 78 Dec. And in Monsieur *de l'Isle's* Thermometer, which he sent me from *Petersburg*, (in which the Heights are changed by the greater or lesser Density of the Mercury, and the Measure is taken behind the vacant Space at Top) I reckoned 142.

But before I treat of the Observation, it becomes necessary to remark Two Things, *viz.* that I suppose, that the Divisions of the Horizon into Degrees Eastward and Westward begin from that Point, where the Meridian intersects the Horizon in the North: And besides, when I mention the Degrees of the Horizon, or Degrees only, I mean those Distances

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which

which can be defined by the vertical Circles reaching to the Degrees mentioned. *

In setting down my Observations, I made use of apparent Time (*p. m.*) Afternoon.

At 5^h. $\frac{1}{4}$, there appeared near the Horizon a blackish Zone, with its upper Limb of a Sky-colour, somewhat obscure. Above this Zone was another very luminous, resembling the Dawn pretty far advanced. The highest Zone was of a red fiery Colour. The Altitudes of the Zones seemed to bear such Proportion, that the Second was double the First, and the Third triple: And, at the same time, they in many Places rose somewhat above the 40th Degree of Altitude. Eastward they extended to the 55th Degree on the Horizon, and Westward to the 70th. They had Three perpendicular slender Divisions, like Slits; but they were parallel to the Horizon, excepting that the Third had some Parts of its upper Limb unequal in Height, with some Asperities upon it; and from the First to the Sixth Degree Westward, a sort of Beam wider than the rest was observed: The Stars of Part of the *Great Bear*, the *Dragon*, *Hercules*, and others, appeared more or less through the *Phænomenon* (and others afterwards, according as the Appearances varied). But through the lower Zone they appeared more obscurely, and in some Places not at all: Through the middle Zone, they shone bright; but through the highest, they were less distinct.

I cannot determine with Certainty the first Moment of the Appearance of this *Aurora*: Nor indeed does it seem feasible, to define the Rise of such *Phænomena* with sufficient Accuracy. But it is worthy

worthy of Remark, that after Sun-set on the preceding Days, as well as this, there appeared in the West a remarkable Redness expanded on each Side: And moreover, on the ensuing Evening, the same bright red Colour, appearing near the Horizon, deceived the common People into a Belief, that a new *Phænomenon*, like the foregoing, was breaking out of the Horizon. Wherefore I am of Opinion, that in this Case there is a considerable Difference between the *Aurora Borealis*, and the Redness occasioned by the Sun's setting.

About Three-quarters of an Hour after, the Length of the Zones was contracted, their Extremities having receded about Ten Degrees from the East and West. The white lucid Part was not now so distinguishable from the red, as before: And this last Colour grew fainter almost every-where else but at the Western Limit, where it was more vivid: But in that Western Space from which the *Aurora* was withdrawn, there remained a brighter Space of Three or Four Degrees, surrounded by a small black Cloud, so that it seemed to be a kind of *Hiatus*. Near our *Zenith* there appeared some thin lucid Clouds, partly of a Whitish-red, in such a manner, that they seemed as if occasioned by the burning of Houses at some Distance to the North. Others of this sort had happened before, and some were seen afterwards.

A little after Six, the upper Parts began to emit red Streamings, or Rays, in Plenty; but in these the Red was now-and-then intermixed with whitish and darkish Colours.

In a few Seconds after, there issued forth from the very *Æquinoctial West*, a red and very bright Co-

lumn, which ascended to the Third Part of the Heavens; and a little after, it became curved in the Shape of the Rainbow.

At Three-quarters after Six, the red Colour appeared fainter, and the Zones were not so distinct from one another; the *Phænomenon* reached only to the 20th Degree East, but to the West it retained its Length, as before.

At Seven, the *Phænomenon* appeared interrupted, and divided into Two Parts, the intermediate Space becoming almost invisible. The red Part of its Western Extremity was curved into an Arch terminating near the Horizon. Not far from the 84th Degree to the West, there appeared a sort of *Hiatus*, not unlike that in the East already described, and which had vanished by this time.

Seven Hours 20 Minutes, the whole *Aurora* was become paler, so that the red Colour was scarce discernible, except at the Western End, where it was of the Colour of Fire.

A little after Eight, the lowermost of the Zones, as they now stood, was blackish; and above this another whitish bright one was seen: And some Parts of these seemed to fluctuate, and be agitated (as it often happened before and after); and, if any of them disappeared, they were soon succeeded by others.

At half an Hour after Eight, almost in an Instant of Time, the bright Zone, from the 8th Degree West to the 50th East, became more vivid, and rose higher; and above this appeared a new large one, of a red fiery Colour, with several successive Streamings tending upward, and passing 60 Degrees of Altitude:

tude: The Western Part had assumed the Form of a thin Cloud.

A little before Nine, at 16 Degrees Eastward, a curved red Beam, (or Bow) though irregular in some of its Parts, rose up to the *Zenith*; and at the same time such another, commencing at the Horizon beyond the 80th Degree West, arose to the same Height, and joined the Eastern Arch in the *Zenith*.

At Nine, after these Beams had been up to the *Zenith* a very short time, they parted, and began to fall considerably lower: But in that Place where they were in Contact, there remained a certain reddish Cloud, which gradually changed in Magnitude and Figure: However, I never observed it to assume that Figure which might properly be called a *Corona*. In some time it vanished, as the other Appearances did from the *Zenith*: Nay, the whole *Phænomenon* grew less, and fainter; and was reduced to the irregular Form of bright Clouds and Beams, whose Light still diminished.

At Three-quarters after Nine, the Western Part was transformed into the Appearance of one Cloud, of a very red Colour, with very little Roughness on its Edges; but it was somewhat more contracted than before.

A little after Ten, the Heavens became brighter from the 84th Degree West, to the 18th Degree Eastward, and to 50 Degrees high, or better.

At 10^h. 36'. the *Phænomenon* was contracted, being now about Ten Degrees in Longitude shorter on each Side. But its upper Part was very red, as if on Fire, with several Rods, or narrow Beams, shooting from it. In a word, the Disposition and Brightness of
its

its Parts came very near the Shape and Vigour the *Phænomenon* had at the Beginning.

At Eleven, the red Part did not afford the Sight of these Rods and Dartings; and the Colour being now fainter and pale, the whole *Aurora* was divided into Two Parts, and the Light was weaker.

In Ten Minutes after, the intermediate Scissure was larger, being now near 20 Degrees; and the Part on the Right Hand ran somewhat East.

About 10^h. $\frac{1}{2}$, the Redness became stronger, but more so to the West than to the opposite Part.

In a Quarter of an Hour, both the Light and Redness diminished; so that the only Space that retained a vivid Light was that of Six Degrees to the West.

At Twelve, the Light of the *Aurora* was nearly extinct, there appearing only a very weak Light along the Tops of the Mountains.

Twenty Minutes after, there appeared a white brightish Beam, at 30 Degrees West, and 60 Degrees high; but it soon became invisible.

In half an Hour after, a very weak Light remained in the West, near the Horizon; which had not been observable, if the Brightness of the preceding *Phænomenon* had not invited me to continue the Observation.

At a Quarter after One, that weak Light was much contracted.

The Tranquillity of the Air continued the same, or nearly such, as in the Beginning; and yet there was not the least Report, or even hissing Noise, heard to issue from so much Matter.

At 1h. 30'. that Part of the Heavens where the *Aurora Borealis* had shone forth, was no ways different from the rest; and the only Light in the Sky proceeded from the Stars, and the Moon, which was now up.

I had at other times observed some luminous Appearances in the Heavens, which may be referred, in some measure, to the Class of the *Phænomenon* above described; but I was of Opinion, that the Memory of this ought to be preserved with the greater Diligence, as it far surpassed all that preceded it in Magnitude, Light, Figure, Colours, and Duration.

3. *Description of an Aurora Borealis observed at the Observatory of the Institute of Bononia, the Night of the $\frac{5}{16}$ of December 1737. By Dr. Eustachio Zanotti, Deputy Professor of Astronomy. Translated from the Italian by T. S. M. D. F. R. S.*

THE *Aurora Borealis*, which was formerly a rare *Phænomenon*, and almost unknown in this our Climate; is now become very frequent. In *Bononia* a great Number have been observed for some Years past, as appears by the Register of the Observations made in this *Institute*. This time it was so very remarkable, that I do not think any one remembers to have ever seen the like. As to its Extent, it spread so as to occupy about 140 Degrees of the Heavens: And, as to its Light, it was so vivid, as by it to distinguish Houses at a great Distance; which seemed of a red Colour, and made some People

attribute this Light to a Fire in the Neighbourhood. But when they were assured what it was, they remained no less frightened, superstitiously believing it impossible, that such an uncommon Light, and of a red Colour too, like Blood, should appear in the Sky without presaging some unhappy Accident. While the whole City was intent upon viewing this new Appearance, I and some young Gentlemen were employed in calculating the *Ephemerides*; and, being apprised thereof, we jointly began to take Observations of it. This uncommon Light drew to the Observatory several others, that were used to come at other times. But I shall only relate what is entered upon the Register of Astronomical Observations, leaving to those who are fond of philosophical Hypotheses, to investigate its Cause according to their Fancy.

7^h. 9'. *p.m.* When we first perceived the *Aurora Borealis*, its Centre was near the North Pole. The Brightness extended along the Horizon about 70 Degrees, and its Height was judged 20 Degrees. The Sky was almost totally overcast with Clouds, but the Light was visible in several Parts, where the Sky was clear. The Two Stars, ζ and ϵ , of the *Great Bear*, shone bright in the midst of the reddish Light of the *Aurora*.

7^h. 34'. No Change having happened for some time, the Light now appeared somewhat weaker, and removed from its Place; for its Centre was no longer in the North, but passed Westward [N. W.]. The Stars, ζ and ϵ , were still visible, but more Eastward, with respect to that Part where the Light was brightest.

7^h. 39'. The Light continued diminishing. To the West, the Sky was quite overspread with Clouds; so that it was not possible to distinguish its Limits.

7^h. 42'. The *Phænomenon* on a sudden reassumed new Strength, and became more vivid, and of a Colour as red as Fire.

7^h. 44'. It again became languid, but was spreading at the same time. To the East, it was not possible to determine its Limits, by reason of the Weakness of the Light, which disappeared by degrees. About the Pole, and to the West, it was lost behind the Clouds.

7^h. 49'. It continued to spread wider, and had already taken in the Two Stars, β and γ , of the *Dragon's-Head*, and *Lucida Lyrae*.

7^h. 52'. The Expansion of the Light still increased, which took in a great Part of the *Swan*, surrounded by a Mist. At this time the Height of the *Aurora* was 40 Degrees, and its brightest Part was a little under *Lucida Lyrae*.

7^h. 54'. On the other Side towards the North, the Two Stars, δ and γ , of the *Great Bear*, were immersed in the Light.

7^h. 59'. The *Aurora* formed itself into a concave Arch towards the Horizon. The Polar Star was near the Top of its Convexity, and some Stars shone bright in the midst of the Light; and, among these, δ and γ , of *Ursa major*. The concave Part was terminated by a Basis somewhat dark; which separated the red Light of the Arch from a white and very bright Light, that remained within it. The Arch, which was 15 Degrees broad, was of a deeper Colour towards the Horizon than towards the Pole. The

Western Limit, which was interrupted by Clouds, was wider and more irregular than the Eastern Limit. TAB. Fig. 1. exhibits the *Phænomenon* conformable to the Description now given.

8^h. 9'. To the West, the Limit of the Arch remained confused, though of a red Colour, somewhat vivid: But to the East it became more faint, and changed rather into a whitish Colour.

8^h. 19'. The red Light spread to the Constellation of the *Dolphin*.

8^h. 22'. The Arch, which was still distinct, grew bigger, passing Eastward by the Two Stars, α and ι , of *Ursa major*, and Westward by the Stars of the *Swan's Tail*.

8^h. 29'. *Lucida Lyreæ* remained clear of the red Light, which moved higher, and was immersed in the bright Light.

8^h. 30'. At the Eastern Limit of the *Aurora*, that is, at 54 Degrees from the North Pole, there was suddenly seen to rise vertically up, a Beam of Fire, at first of a very bright Light; but, in Process of Time becoming more resplendent, it changed into a red Colour, like that of the Moon in the Horizon.

8^h. 31'. The Light still increased in Vigour, and was now intirely like the red Rays, which are separated by the Prism. Its Figure was changed; for it resembled a Pyramid, with its Basis on the Horizon, 4 Degrees wide, and its Height was about 20 Degrees. Near the Top of the Pyramid, the Redness was less than at the Basis, and its Limits were not very distinct.

8^h. 34'. The red Light continued spreading, and made, as it were, a Basis of a weaker Redness, for the

the aforeſaid Pyramid. At this time the *Aurora* appeared unfettled and curious, as in Fig. 2. TAB. V. At its Eaſtern Limit, the Pyramid continued viſible, but of a more intense Colour towards the North, and from its Middle there ſhot up vertically a Streak of Light, between a white and a yellow Colour. A very dark narrow Cloud croſſed the whole *Phænomenon*, and went to terminate in the Pyramid. At the upper Part, a conſiderable Tract of the Heavens was enlightened with a very vivid red Light, which was interrupted by ſeveral Streaks or Columns of a bright yellowiſh Light. The ſaid Streamings ſhot up vertically, and parallel to each other; and the narrow Cloud ſeemed to ſerve them for a Baſis. Under the Cloud there iſſued forth Two Tails of a whitish Light, hanging downward on a Baſis of a weak Red, and it ſeemed as if they kindled and darted the Light downward. There was likewiſe ſeen a white Streak, which paſſed acroſs theſe Two Tails, and extended from one End of the *Phænomenon* to the other, in a Poſition almoſt parallel to the above-mentioned Cloud. Weſtward, the Sky was all cloudy, ſo as to ſuffer nothing to be obſerved. At this time ſome of the Company perceived other little Shootings, like thoſe which are frequently ſeen in Summer, and are commonly called *falling Stars*. More than one of theſe were obſerved in that Part of the Heavens that was free from the *Phænomenon*, at about 45 Degrees of Altitude, not far from the Eaſt.

8^h. 36'. There reappeared a Portion of the Arch, which was ſeen at firſt. The Pyramid was ſpreading, and loſing its Figure.

8^h. 38'. The very bright red Light, which first formed the Pyramid, spread Northward on the Tracks of the Arch; which nevertheless contained within it a bright Light extending to the Horizon, excepting that it was covered here-and-there by Clouds.

8^h. 39'. The Stars, ζ , ϵ , of *Ursa major*, shone through the red Light, which contained several white luminous Streaks.

8^h. 44'. The red Light, now very vivid, was all interspersed with white luminous Streams, which darted out of the Basis or lower Extremity of the Arch. To the West, the Northern Light terminated exactly in a white Streak, and Eastward it spread as far as the Horizon. The North Pole began again to become red, yet there still remained somewhat of the usual bright Light between the Red of the Pole, and that of the Arch.

8^h. 51'. The red Arch began also to appear to the West, and reached to the Stars of the *Swan*, which at first were hid by the Clouds.

8^h. 54'. The red Light began to spread on every Side, but still contained within it somewhat of the Brightness. The *Zenith* was now all red, and with it that Part of the Sky which takes in 70 Degrees on each Side. Fig. 3. TAB. V. exhibits the *Phænomenon* as it was observed at that Time. The Circle described by the Figure denotes a Parallel to the Horizon at the Altitude of 45 Degrees; on which is a Portion of the Arch, so often made mention of.

8^h. 56'. There appeared several white Streaks to the East, where the Light of the *Aurora* was strongest; which Light was rising higher, and seemed to have in-

intirely quitted that Part of the Sky near the Horizon.

9^h. 4'. There now remained but a little reddish Light at the North Pole; all the rest was collected near the *Zenith*, not extending lower than the Star α of *Ursa major*. In the South, where the Sky was clear, there were seen some of those Stars which we have called *falling Stars*.

9^h. 6'. About the *Zenith* the Light continued red and vivid, but descended lower. The *Aurora* abandoned the East, and took Possession of the North-west. It appeared as if the Coruscations had almost constantly taken their Rise from the Eastern Quarter, and afterwards extended to the West.

9^h. 9'. A considerable Streak, or Tract of red Light, more vivid than the rest, crossed the Stars of the *Swan*, almost horizontally.

9^h. 12'. In the East, where the *Aurora* seemed to have intirely disappeared, it began again to make its Appearance; but to this Time the Light was but faint, in comparison of that which was seen in the Beginning.

9^h. 19'. The Light was become pretty faint, and confined within a small Space, at the Height of about 40 Degrees, above the North-west. Many little Changes, that occurred, are not set down, it being impossible to keep an Account of them all, inas-much as they succeeded one another very quick.

9^h. 34'. The *Aurora* seemed intirely extinguished. In some Minutes after, it began to revive; but the Clouds, which were in great Numbers, and spread round on every Side, left but a few little Spaces free. The greatest Brightness was in the *Zenith*, which

which appeared like a red Veil, declining to the North, where it lost itself behind the Clouds.

11^h. 6'. The Light gathered new Strength, and was all at North, up to 20 Degrees of Altitude, the *Zenith* being quite clear of it. The Brightness was greatest about the Pole, and grew weaker as it receded from it, taking in, upon the Whole, 90 Degrees of the Horizon. The Clouds continued to increase, and prevented seeing the *Phænomenon* but now-and-then; and in this manner the Light lasted to the 13th [15th] Hour. Some say they have seen Foot-steps of it at the 16th [4th] Hour; but our Company parted long before from the Observatory, thinking it intirely at an End; and the rather, because the Clouds had deprived us of all Hopes of being able to pursue the Observation.

I shall add some things which have been courteously communicated to me by the celebrated Dr. *Beccari*, and are of his own Observation.

The Day of the *Aurora*, the Barometer was very high, *viz.* at 28 Degrees $\frac{1}{2}$ Lines. The preceding Day, the Winds were different, in different Regions of the Air. Near us [the Earth], the Wind was West-north-west, and pretty cold. Higher up, the Clouds came from the East, and moved Westward; which Clouds were globular Collections of Mists. Above that Region the Wind blew at South-west by South, as appeared by some small Fleaks of Clouds coming from that Quarter. The 16th Day, the Wind that reigned in the Region of the Clouds was *Greco-tramontana*, and was in the Second Degree of Strength.

Several Persons have positively assured us, that, in the Evening of the 16th Day, they perceived a certain Stench in the Air, like that which is sometimes occasioned by a Fog. The same has been taken notice of at other times, when such *Phænomena* have appeared.

There was a very thin Fog in the Air not only on the 16th Day, but also on the preceding and ensuing Days. The Mornings of the 17th and 18th, before and a little after Sun-rise, the Air appeared of an uncommon fiery Colour. The Evening of the 17th, the Crepusculum was of an extraordinary Height. Between the North and West, there was seen a very thin red Vapour, which lasted almost till Night.

The various Appearances of the *Aurora*, observed by that Gentleman, are here omitted, because they very well agree with those above described.

4. *Splendidissimum lumen Boreale Romæ visum die*
16. Decembri 1737. *Observante* Didaco de Revillas,
Abbate Hieronym. pub. Math. Prof. & Reg. Societ.
Londinensis, necnon Acad. Scient. Inst. Bonon.
Socio.

ET SI hora dumtaxat p.m. VII. cum semisse de
splendidissimo cœlum illustrante lumine monitus
ejus observationi vacare cœperim; abs oculatis tamen,
& fide dignis testibus hæc accepimus: nimirum, 1^o.
Crepusculo vix finito humiliorem cœli borealem
plagam rubro colore infectam, ignitamque conspici
cœpisse; nonnullis postmodum albicantibus striis inde
af-

affurgentibus. 2°. A boreali versus occiduam plagam paullo post incensionem declinâsse; striis modo evanescentibus, modo iterum conspicuis, quæ duobus albicantibus arcubus concentricis, & horizonti proximis, ad aliquod tempus insistebant. 3°. Prope horum fimbrias vividius lumen ex horizonte ejaculari. 4°. Demum boream versus hora circiter VII. conflagrationem denuo migrâsse; arcubus jam tunc evanescentibus. Hæc ab aliis: en a nobis observata.

H. VII. 30'. Igneum rubrumque lumen, coelo sereno ac quieto, borealem plagam illustrabat, quod ad altitudinem graduum circiter 8 protendebatur, amplitudine in ortum gr. 10, in occasum gr. 35. fixis trans lumen emicantibus. Prope horizontem insueto candore veram auroram æmulante coelum splendescbat.

40'. Nigricans stria versus Polarem stellam affurgebat; atque interea temporis sanguineus color sensim propagabatur.

H. VII. 45'. Inter gr. 26 & 30 a borea occasum versus major conflagratio colligebatur; ibique duæ leviter albicantes striæ nonnihil inferius convergentes in sublime levabantur. Paullo post ad altitudinem gr. 40 conflagratio conscendebat: boreali plaga vix ad sensum rubescente.

H. VIII. Ubi paullo ante vividior inflammatio, minuebatur. Ad boream tamen, & ad ONO. ulterius ad altiora coeli progrediens, iterum accendebatur.

15'. Horizontalis candida lux sub elevationis angulo gr. ferme 7. apparebat in tota boreali plaga. At quæ superiores occupabat partes, nonnihil ad horizontem prope NO. conflagratio pertingebat. Forte arcus figuram candor hicce nanciscebatur; sed interjecta ædi-

ædificia ejus conspectum prohibebant. Paulo post ad gr. occid. 32. a borea ruber color ferme evanescebat. Ad boream, & ad NO. intendebatur. Interea temporis circa Lucidam Lyræ area propemodum elliptica, vivido colore rubra, majori axe ad horizontem normali apparebat; ex qua candicantes striæ versus coeli summmitatem emittebantur. Alia vero pariter candicans ab ellipsis imo ad Ursæ majoris caput extendebatur. Arcæ major axis gr. circiter 10 occupabat.

20'. Nova hæc elliptica conflagratio sensim elevabatur; & nonnihil ad occasum declinans a Lucida Lyræ recedebat, trilateram, seu potius circuli sectoris figuram, converso ad horizontem arcu, assumendo. Sectoris hujusce centrum obtinebat stella in Cygni pectore emicans. Sub idem fere tempus a boreali conflagrante plaga resplendens stria versus sectoris centrum inclinata figuram trapetiam intermediam ferme obtenebratam terminabat.

45'. Lucidus circuli sector evanescebat. Nubes nigricans intra gr. 28 & 34 a borea in occasum. Conflagratio pene tota exstinguebatur præterquam circa Polarem stellam.

50'. Iterum inter Polarem, & Ursæ majoris caput colore sanguineo perfusum lumen vel maxime accendebatur ultra graduum 60 altitudinem protensum. Arque interim occasum versus alia coeli portio conflagrabat a priore sejuncta. Paulo post interjectum quoque spatium superius inflammabatur, relicto prope horizontem ad NNO. albicante lucidoque intervallo.

H. ix. Conflagratio major circa Ursæ majoris caput. Rubra lux ferme usque ad *Zenith*; iterumque versus occidentem plagam diffundebatur. Plures nigricantes striæ nonnihil inferius convergentes intra

conflagrationem attollebantur, quarum amplior Polarem attingebat.

H. ix. 10'. Striæ evanescebant, vegetiore conflagratione supra Ursæ majoris caput perseverante; & ad horizontem usque paullo ante albicantem sese extendente.

15'. Major conflagratio circa Polarem. Totum tamen boreale hemisphærium plurimum rubebat.

20'. Ad gr. 32 a borea in occasum, ampla candicans stria assurgebat; & circa Ursam majorem minuebatur accensio. Intra gr. 30 & 34 perseverabat; ubi adhuc rubro colore horizon, occasum versus albescens, inficiebatur.

30'. Plurimum languescbat accensio: iterumque juxta boream intendebatur.

40'. Evanescebat iterum, tenui occasum versus perseverante fulgore, qui tardius, sed pederentim extinguebatur.

H. x. Iterum ad boream inflammatio, quæ nonnihil orientem versus protendebatur; inter utramque tamen accensionem spatio gr. circiter 15 interjacente; in quo, utrinque evanescens conflagratio, satis tamen diminuta, mox colligebatur.

15'. Occasum versus cœlum nubilum. Solus horizon fudus. Conflagratio jam extincta, vix tenui ad boream rubicundo colore superflite.

H. xi. Iterum ad NNE. reviviscens ad medium usque noctis perseverabat. Sensim deinde minuebatur. At quæ supererat dubia lux aërisque rubor, vix post duas horas evanescebat.

Die 16h. 9'. a. m.	Barom.	28. 1.
h. 9. p. m.		28. 1 $\frac{1}{10}$.
D. 17h. 7. a. m.		28. 1.

5. En-

5. *Extract of a Letter from Mr. James Short to Mr. George Graham, F. R. S. dated at Edinburgh, Dec. 6. 1737. concerning the same Lights.*

— **Y**esternight we were surpris'd upon looking out at the Windows, about Six o'Clock, to find the Sky, as it were, all in a Flame; but upon further Inquiry, it was nothing but the *Aurora Borealis*, compos'd of red Light. There was an Arch of this red Light reach'd from the West, over the *Zenith*, to the East; the Northern Border of this Light was tinged with somewhat of a blue Colour. This *Aurora*, as far as I saw, did not first form in the North, and after forming an Arch there, rise towards the *Zenith*, as they commonly use to do; neither did the Light shiver, and by sudden Jirks spread itself over the Hemisphere, as is common, but gradually and gently stole along the Face of the Sky, till it had cover'd the whole Hemisphere; which alarm'd the Vulgar, and was indeed a strange Sight: In some Places we saw the Clouds pass betwixt us and it. During the whole Time, which was from Five o'Clock till Eight, there was a most violent Wind from the South-west. I look'd at *Jupiter* with $15\frac{1}{2}$ Inch Telescope, but the Air was in such an Agitation I could not see him distinctly. *Lucida Lyrae* appear'd through the red Light very dim to the naked Eye. About Eight o'Clock this red Light form'd a *Corona*, a little to the South of the *Zenith*; and instead of a dark Fund in the Middle, as usual in such Occasions, it was of a deep Red. There was always

a great Circle of this Light came from the West to the *Zenith*, which seemed to be the Magazine whence all the rest were supplied. It is but about a Year since I first observed this red Light in the *Aurora Borealis*, and only then in very small Quantities. I shall be glad to know if there is any such Alteration in the Light at *London*.

6. *An Abstract of a Letter from John Fuller, Esq; jun. F.R.S. to the President, concerning the Red Lights seen Dec. 5. 1737.*

*** **I**T was a strong and very steady Light, as near as can be of the Colour of red *Okre*; it did not seem to dart or flash at all, but continued going on in a steady Course against the Wind, which blew fresh from the South-west. It began about North North-west, in Form of a Pillar of Light, at about 6^h. 15'. in the Evening; in about 10 Minutes, a Fourth Part of it divided from the rest, and never joined again; in 10 Minutes more it described an Arch, but did not join at Top; exactly at Seven, it formed a Bow, and soon after quite disappeared; it was all the while lightest and reddest at the Horizon: It gave as much Light as a Full Moon.

At 8^h. it began again exactly North: It was very light then, but not near so light as before; in half an Hour it made an Arch from East to West, and went quite away to the South, when it ended much with the same Appearance as it began in the North, but not quite so red.

Rosehill, [Sussex] Dec. 20. 1737.

VIII. *A short Account of Dr. Jurin's Ninth and last Dissertation De Vi Motrice, by Mr. John Eames, F. R. S.*

THE last Dissertation is * new, and treats of the Motive Forces of Bodies, whether they are to be estimated by the Velocities, or the Squares of the Velocities, when the Masses are equal. The Original of this Dispute among the Mathematicians, the Author ascribes to a Slip committed by the celebrated Mr. *Leibnitz*, in the Year 1686. and the Continuance, to the Neglect of the Times, wherein equal Effects are produced. The one Side asserts all Causes to be equal, whose Effects are so, whether the Times, during which the Causes act, are shorter or longer. The other, on the contrary, maintains, that equal Effects may arise from unequal Causes, if the Times of Action are unequal; that consequently the Times, as well as the Effects, ought to be taken into the Account.

He wishes the Gentlemen on the other Side of the Question would produce some Experiment in their Favour, where the Equality of the Times is preserved; since all the Experiments they have hitherto made, and argued from, may justly be set aside, as incompetent, on the Account of the Inequality of the Times of Action.

* The Eight preceding Dissertations had been before printed separately; but were now all collected together, with the Addition of this Ninth, and published in one Volume in *Octavo, London, 1732.*

The Author then proceeds to prove the Truth of the common Opinion of the Forces in equal Bodies being proportional to their Velocities. This he does by Three Mediums, the First taken from the Action of a single Spring upon the same Body : The Second from some Experiments of Mr. *Mariotte* ; the Third from the joint Action of several Springs upon Two unequal Bodies.

I. A single Spring, fixed to a moveable horizontal Table, is made to communicate to the same Body, Degrees of Force unquestionably equal, while the Degrees of Velocity communicated at the same time are also undoubtedly equal ; therefore the Forces are proportional to the Velocities.

II. In Mr. *Mariotte's* Experiments, the Impressions made upon equal Surfaces in the same Point of Time, are found to be in the Duplicate *Ratio* of the Velocities ; but the Masses or Numbers of impinging Particles are in the simple *Ratio* of the Velocities ; consequently, the Masses and Velocities conjunctly being in the Duplicate *Ratio*, *i. e.* as the Impressions, must also be as the Forces which made them : Which is the old Opinion.

III. A complicated or bent Spring interposed between Two unequal Bodies, acting upon each with an equal Pressure, and during an equal Time, must communicate equal moving Forces to each ; but their Velocities are by Experiment reciprocally proportional to their Masses ; therefore their Masses, drawn into their respective Velocities, are also equal, as were their moving Forces ; and by consequence their moving Forces are as the Masses and Velocities conjunctly : Which is the generally received Opinion.

In

In the Appendix, the Author answers some of the principal Arguments brought in favour of the contrary Side.

I. The first is drawn from the compound Motion of a Body along the Diagonal of a Rectangle, whose Sides represent the simple Motions. Here it is said, that the simple Forces are no-ways contrary to each other; that being united or added together in the compound Force, that compound Force will not be to both or either of the simple Forces, as the Diagonal is to both or either of the Sides; but as the Square of the Diagonal to the Sum of the Squares of the Sides, or to the Square of either Side respectively. He answers, The simple Forces, while they act in their proper Directions, are not contrary to each other, either Wholly or in Part; but when considered as contributing to the Motion of the Body in the Direction of the Diagonal, Part of the one acts contrary to Part of the other, and destroys it; as is evident, if you resolve each simple Force into two others, one acting along the Diagonal, the other in a Direction perpendicular to it. And then it is to be observed, that the Sum of the two former is equal to the Diagonal (while the two latter destroy each other): Which is perfectly agreeable to the old Opinion, but not at all to the new; for the demonstrating of which this Argument is brought.

II. The second Proof is taken from the equal Compression of Four equal Springs, before the Force was consumed, by the same Body moving with double the Velocity; and labours at the Bottom under the same Parallogism.

III. The

III. The last Argument is founded upon the learned and ingenious Mr. *Poleni's* Experiment, wherein equal Cavities are formed in soft Substances, by equal Bodies falling from Heights reciprocally proportional to their Masses. This the Author sets aside, as insufficient, since the Times of forming these equal Cavities are unequal, and unequal Causes may produce equal Effects in unequal Times. The learned Mr. *Poleni* does, indeed, reply, and say, that the Formation of these Cavities seems to be instantaneuous: But the ingenious Author shews the contrary, and that from a Position allowed of by *Poleni* himself, in his Reply.

IX. *An Account of some remarkable Stones, taken out of the Kidneys of Mrs. Felles, upon opening her Body after her Decease, by Noah Sherwood, Surgeon.*

UPON opening the Body of Mrs. *Felles*, I found nothing amiss in any of the *Viscera*, till I came to the Kidneys, both of which were considerably enlarged, and of an oblong Figure, and had several Protuberances bunching out, which made the Surface appear almost like a Beeve's Kidney. Upon feeling them externally, I could plainly perceive they were caused by Stones: I took them out of the Body, and laid them open Longitudinally, and found in the Right Kidney several Stones of an irregular Figure, branched like Coral: They had extended themselves beyond the Capacity of the *Pelvis*, on every Side,
(al-

(although that was greatly enlarged, so as each of them to contain half a Pint of *Pus*, or more) forming for themselves Cells in the *Parenchyma* of the Kidneys, which Cells were all ulcerated within, and full of Matter, communicating with the *Pelvis*; the whole Substance of the Kidneys was scirrhus. The Patient had long been troubled with grievous Pains of the Back, and had voided great Quantities of *Pus* with all the Urine she made, so that there was no doubt of there being Ulcers in her Kidneys; and she herself often declared there were Stones in the Kidneys, which, upon any Motion, she could feel grate against each other. The Bladder and Ureters seemed to be less hurt by so long a Discharge of Matter than might reasonably be expected, being only a little excoriated; and indeed less than I have found in other seemingly parallel Cases, where the Matter has been of a more corrosive Nature; but in this Case it was thick and smooth.

The Left Kidney was likewise full of Matter, and contained only One Stone, larger than any of those in the Right, nearly of a triangular Figure, with the Angles growing pointed at their Extremities.

X. *A Description of a large Lake called Malholm Tarn, near Skipton in Craven, in the County of Yorkshire; by John Fuller, Esq; jun. F. R. S.*

Malholm is a pretty Country Village, situated on the Southern Side of a monstrous high Hill, the Ascent of which is not very steep. By a Break between this Hill and another, which are joined by a Rock, which measures 82 Yards perpendicular, and seems to be about Two-thirds of the Height of the Hill, I conclude the Hill to be about 120 Yards perpendicular. On the Top of this Rock there still remains the Appearance of a Chancel for 2 or 300 Yards together, which, by its having no Mould or Earth to cover it, I judge to have been a Passage for that Water, which formerly used to tumble over the Precipice, but now has found a Passage under-ground, and flows out at the Bottom of the Rock, being now called *Air-Head*, viz. the Head of the River *Air*. The Rock is called *Malholm Cove*.

Between the Top of this Mountain and the Tops of Four others, is *Malholm Tarn* * (I say the Tops of them, for though they steep a Quarter of a Mile towards the Lake from their Tops, it is at a Mile and an half down to the flat Country on the Outside). This Lake is between 3 or 400 Acres. The Shape of it is a Parallelogram, the Length of which equals about twice the Breadth: There are no Weeds in it. In a fine still Day, you may see the white chalky Bottom, where it is 10 or 12 Foot deep. I wonder

Camden

* A Saxon word for a Lake.

Camden takes no Notice of this Lake; for it must have been there in his Time, and he must have been very near it; for he describes a Precipice, which I am pretty certain is the Northern Side of one of those very Hills which help to form *Malholm Tarn*. There are but Two visible Springs that supply it with Water, one lies East, the other North-west; and by what I could guess, there are only these Two Springs; for the Discharge seems to be no greater than what these Springs supply.

The superfluous Water of this Lake is discharged by a gliding Stream, about Four Feet broad, and Two or Three Inches deep; which runs above-ground about 2 or 300 Yards, and then dips under-ground at Two different Places about 10 Yards distant from one another. What becomes of these Streams after their dipping, (though the Relation appears somewhat fabulous, yet) as it is affirmed by all the Men of Credit in the Neighbourhood, I could not help believing it. About a Mile below *Malholm* Village there are Two Springs that discharge themselves into the River *Air* about 10 Yards distant from one another, one somewhat greater than the other. The Neighbours assured me that if Wheat-chaff was put into either of the Rivulets at the Place of their dipping, in about Eight Hours time it would come out at the greater or lesser Spring, and not out of both, into the River *Air*, which is from the Place of their first dipping about Two Miles and an half. By this it appears, that these Two Rivulets never communicate in their subterraneous Passage.

The *Tarn* abounds with only Two sorts of Fish, *Trouts* and *Perch*: The *Trouts* very large and red; the

Perch far exceed in Size and Goodness any I have ever seen, being commonly 20 Inches long, weighing Four or Five Pounds. They are taken only with Hooks, it being so deep and stony, that you cannot draw a Net: The only Bait for them is an Earth-worm; the rocky Soil, and the Springs coming so little a Way, affording them very little of that sort of Food.

XI. *Extract of a Letter from Monsieur de Bremond, M. D. to Dr. Mortimer, concerning a File rendered Magnetical by Lightning. Translated from the French by T. S. M. D. F. R. S.*

IN N° 437. of the *Philosophical Transactions* you have published, Sir, a Letter of Dr. *Cookson*, of *Wakefield*, on an extraordinary Effect of Lightning, which communicated Magnetism to several Iron Tools I have received a Letter from the Coast of *St. André* in *Dauphiné*, dated *Sept. 7. 1739.* giving an Account of a Fact of the same Nature, which I here send you as I received it.

“ Three Weeks ago the Lightning fell 30 Paces
 “ from my House on that of a Clock-maker. I shall
 “ not enter into the Particulars of the Ravage it
 “ committed. Every-body knows how surprising
 “ the Effects of Thunder are: But here is one that is
 “ very singular. The Thunder broke one of the
 “ Clock-maker’s Files, four Inches from the End;
 “ so that there still remained Seven Inches of it in the
 “ Handle;

“ Handle ; and the Piece of Four Inches long, that
 “ was broke off, remained on the Shop-board.

“ The next Day after the Accident, the Clock-
 “ maker, observing that the remaining Part of this
 “ File might still be of Service to him, took it up,
 “ and worked with it. But he was much surpris’d
 “ to see, that Iron followed the End of his broken
 “ File. He applied this End to a Punch (or Drill),
 “ and the Punch was immediately attracted to the
 “ File. He called to me, and I made several Trials
 “ of this attractive Quality. I took the Piece of the
 “ File that had been broken off, and applied it to an
 “ iron Ring for hanging Keys ; which it lifted up
 “ perfectly well, and held suspended as long as I
 “ thought proper. I doubted not but it was the
 “ Lightning that had communicated a magnetic Qua-
 “ lity to this File ; and I found, upon Trial, that this
 “ Quality was given only to the Inside of the File,
 “ and the broken Piece ; for I applied Bits of Iron to
 “ every Side of it, without any Effect, the Virtue
 “ residing no-where but in the Place that was broken.
 “ I broke in two the same Piece of Four Inches ; and
 “ one of the Two Pieces attracted Iron at both Ends,
 “ the other only at its broken End. I rubbed the
 “ Point of my Knife on one of these two Bits of
 “ the File, and it communicated to my Knife a De-
 “ gree of Magnetism sufficient to raise Needles, and
 “ hold them suspended.”

I wish, Sir, this Observation may prove agreeable
 to you: It will serve at least to multiply the odd
 Effects of Lightning, and the Wonders of Mag-
 netism.

I have the Honour to be with all possible Esteem
and Respect,

S I R,

*Your most humble and
most obedient Servant,*

Paris, June 4. N. S.
1740.

De Bremond,
*of the Royal Academy
of Sciences.*

XII. *An Account of Tumours, which rendered the Bones soft. Communicated to the
ROYAL SOCIETY by Mr. Pott, Surgeon.*

IN November 1737. a Gentleman, aged 27, complained to me of a Swelling in the Inside of his Right Thigh (being in every other respect in perfect Health). Upon Examination it appeared to be an encysted Tumour of the Steatomatous kind, lying loose between the *Sartorius* and *Vastus internus* Muscles. I told him, I could propose no way of curing it, but by taking it out; which was accordingly done, and he very well in Six Weeks.

After this he continued well for near a Year (except that he now-and-then complained of a slight Pain in the Joint of that Hip, which went off and returned at different times); and then fell into such a Disposition to sleep, that no Company or Diversion, nor his own Endeavours to the contrary, could
keep

keep him awake after Eight or Nine o'Clock in the Evening, if he sat down.

This continued on him for Three or Four Months, and then the Pain in his Hip grew worse; for which he used the Cold-bath, Flesh-brush, and riding on Horseback, but without any Effect.

Hereupon he asked the Advice of Dr. *Beaufort*, who put him into a Course of the *Æthiops Mineral*, *Cinnabar* of *Antimony*, and *Gum Guaiacum*, with the *Spa-water*, and purging with *Calomel*, by Intervals: This Method he pursued for a considerable time, but without any Benefit.

After this, by the Advice of some Acquaintance, he took half a Drachm of *Salt* of *Hartshorn* Night and Morning, in a Draught of warm *Whey*, for some time; but without any sensible Effect, even by Perspiration.

Some little time after this, he began to complain of a slight periodical Heat and Thirst, which returned every Night, with a quick hard Pulse, but which was not so great as to make him uneasy.

It was now *September* 1739. when, having an Opportunity of going with some Friends, he determined to try what the *Bath* would do for him: In his Journey thither, the nocturnal Heat and Thirst increased so much, as to prevent his sleeping; but in the few Days that he spent in recovering from the Fatigue of the Journey, they seemed to go off again.

He then began to use the Waters both internally and externally; upon which the last-mentioned Symptoms again appeared, and he was obliged to desist, and use cooling Medicines.

His Physicians then advised him to bathe the affected Limb only; upon which they returned again, and with such Violence, that the farther Use of the Waters was thought highly improper, and he left them off.

During this time the Sight of his Left Eye grew dim, which Dimness increased gradually for some little time, till he became quite blind of that Eye; the Bulb of it being considerably enlarged, and thrust forward out of the Orbit.

For the most part of the Time he had been at *Bath*, he had generally been very costive; and, upon leaving off the Water, had no Stool for some Days; for which Reason a common Clyster was given, and produced so profuse a Discharge of serous Matter, and continued for so many Hours, (almost incessantly) that he was reduced as low as possible.

For some time past, several small Tumours had appeared in different Parts of him, *viz.* Five or Six on his Head, Two or Three in his Back, and one in the Neck, all lying just under the Skin, and sensibly increasing every Day, till they came to a considerable Size.

December the 2^d 1739. he returned to *London*.

His chief Complaints now were an excessive Languor, an Inability to move his Right Hip (and when moved by another Person, a very acute Pain in it); an Incapacity of sleeping when in Bed, and an intense Thirst in the Night, with a quick hard Pulse.

He now took the Advice of Dr. *Hartley* and Dr. *Shaw*, who prescribed him the *Cinnabar* of *Antimony* Three times a Day, to drink the *Selters* Water, and keep to a cooling Regimen; and allowed him

him a moderate Dose of the Pill *Matthæi* every Night; by means of which he got some Sleep, of which he had for some time been absolutely deprived.

When he had taken the *Cinnabar* Five or Six Days, and during that time had no Stool, it was thought proper to give him a Clyster; which brought away all the Medicine, without the least Alteration; nor was there ever after this Time any Appearance of any *Mucus* being secreted by the Intestinal Glands, he never going to Stool above once in a Week (and then there came away a few Lumps of Excrement as hard as Pieces of Wood); which were expelled with such Labour and Fatigue as can hardly be imagined; though he generally took an oily Clyster to render it more easy, and washed down his Medicines with a soapy Draught.

The Joint of the Hip was now become quite stiff, all the Inguinal Glands being loaded with the same kind of Matter of which the other Tumours seemed to be composed; and a large Cluster more of them might be felt under the *Glutei Muscles*, and behind the *Trochanter*.

The *Cinnabar* was now left off, and mercurial Unction proposed and consented to; and accordingly a proper Quantity was rubbed in every Night, stopping now-and-then to see what Turn it would take; and in this Course he continued for more than a Month, but without any Benefit, nor did the *Mercury* produce any visible Effect on him.

Sir *Edward Hulse*, being called in, directed the burnt Sponge, which he took for some time, till, growing worse and weaker, he determined to try Mr. *Ward*.

He took his sweating and purging Medicines Two or Three times, but found no sort of Effect from them; and being now quite tired of Physic, and reduced extremely low, he determined to pass the rest of his Time as easily as he could, by gradually increasing his Opiate; and in this manner languished, incapable of stirring or helping himself, till the 2d of *May* 1740. and then died.

For a considerable Time before he died, he was nourished by Fluids only: Yet, as soon as ever they were received into the Stomach, in however small Quantity, they gave him an acute Pain at the Bottom of his Belly, just above the *Pubis*.

For Two Months, or more, before his Death, he could never make any Water while he was up, but always made a good deal at different times when in Bed.

Soon after his Return to *London*, I opened the Tumour I had taken out of his Thigh Two Years before, and found the Inside of it ossified.

Upon Dissection, the first thing that offered itself was a large Tumour on the *Sternum*, which had been perceived about Three Months before he died: It was as large as a *Turkey's Egg*, and so hard and immovable, that I was in doubt whether it was upon or under the Bone.

Upon removing the Skin, it appeared covered by the Expansion of the Tendons of the intercostal Muscles, and the *Periosteum*: This Coat being taken off, it was of a fleshy kind of Substance for about half an Inch deep; and below this was a kind of Cartilage intermixed with a great many bony Particles.

I then shaved off all this diseased Body even with the Surface of the rest of the *Sternum*, but found no Bone, it being quite dissolved and confounded with the Mass of Matter that composed the *Tumour*, which was equally protuberant within the *Thorax*, and composed of the same Materials.

Part of the Fifth and Seventh Ribs were dissolved in the same Manner, into a kind of Substance between Bone and Cartilage, with a thick Coat of sciatomatous Matter.

Within the Cavity of the *Thorax* were Thirty-seven of these diseased Bodies, most of them attached either to the *Vertebrae* or the Ribs; and where-ever they were attached, the *Cortex* of the Bone was destroyed, and its internal cellular Part filled with the diseased Matter.

Immediately above the *Diaphragm* was a large scirrhus Body, lying across the Spine and the *Aorta*, the latter of which lay in a *Sinus* formed in its lower Part; it had no Attachment to any other Part, and weighed 13 Ounces and a half; and from its Situation, I think, must have taken its Rise from some of the *Lymphatic Glands* lying about the *Thoracic Duct*.

From the Origin of the *Aorta*, from the Heart, quite up to the Basis of the *Cranium*, all the Blood-vessels were surrounded with these scirrhus Bodies, and the *Thyroid Gland* was diseased in like Manner, and bony within.

On the Left Side was another of these Bodies, made out of the *Glandula Renalis*, weighing Nine Ounces Three-quarters.

On the Right, the *Glandula Renalis* was in a natural State; but the *Cellular Membrane*, which surrounds the Kidney, was filled with a large Cluster of these Bodies of different Sizes, some of them intirely suetty, others intermixed with bony Particles: Three or Four of them were attached to the Body of the Kidney, and these were a sort of *Cartilage*, beginning to ossify.

The *Pancreas* was quite scirrhus, and very large.

One very large *Tumour* sprung from the spongy Body of the Third *Vertebra* of the Loins, the bony Texture of which was so dissolved, and mixed with the Matter of the *Tumour*, that the Knife passed through it with great Ease.

The inner Side of the *Os Ilium*, all the *Ischium* and *Pubis*, were covered with these Appearances; and, upon removing them, the Bone was found in the same State as the *Sternum* and Ribs.

The Middle of the Right *Os Femoris* was surrounded with a Mass of the same Matter, and the Bone underneath in the same State.

In the Bottom of the Orbit, surrounded by the *Recti Muscles*, was a pretty large *Steatoma* which occasioned the Protrusion of the Eye; and, by pressing on the Optic Nerve, (in all Probability) the Blindness.

XIII. *A Case wherein Part of the Lungs were coughed up. Presented to the ROYAL SOCIETY by William Watson, F. R. S.*

Thomas Halsey, aged about 70, of a short Make, and pretty fat, being in a tolerably good State of Health, (unless, as for some Years past, troubled with frequent coughing upon Motion) was seized *Sept.* 23. 1740. with a violent Fit of Coughing, in which he fell down, as the By-standers thought, dead, and discharged near a Quart of Blood at his Mouth, in a very large Stream, mixed with many Portions of a seemingly grumous Matter. His coughing Fit continued near Three Minutes. He revived upon bleeding at the Arm, and, being put to-bed, recovered his Senses, and (as he said) was perfectly easy, and free from Pain, except upon Coughing, which as often as he did, he spit Blood visibly arterial from its florid Colour. About Four Hours after the First Fit, he was taken with a Second, attended with the same Symptoms as the First; and expired in it. Upon examining the Blood, which he brought up at his Death, I found, in Pieces of different Sizes, near Three Ounces of the Substance of the Lungs, not ulcerated, or any ways distempered; and I have Reason to believe there was near the same Quantity of the Lungs thrown up during the First Fit of Coughing. The Pieces were easily distinguishable from grumous Blood, by their connecting Membrane, the *Acini* in the internal Part, and their specific Gravity.

Upon

Upon examining the Contents of the *Thorax* after Death, the Right Lobes of the Lungs were found, of a good Colour, and no-ways injured: In the Left Cavity of the *Thorax*, there was a large Quantity of extravasated Blood; the inferior Left Lobe adhered strongly both to the *Pleura* and *Mediastinum*, and was somewhat decayed; but of the superior Left Lobe, the upper Part next the *Trachea* adhered to the *Pleura* for about Two Inches; and the Remainder, where there had been no Adhesion, (as I could perceive from the smooth Surface of the *Pleura*) was torn away by Pieces, and discharged in Coughing. As the greatest Part of the Left Side of the Lungs was tied down to the circumjacent *Membranes*, the Person being old, and the whole Force of the *Parietes* of the *Abdomen*, *Diaphragm*, &c. in the Action of coughing, was unequally exerted upon that Part that did not adhere, and which, by the Violence of the Pressure, was torn off from the rest, and discharged, as I just now mentioned; it is worthy Observation, how small the Degree of Sensibility is in the Lungs; that a Person should lose so much of their Substance, as in this Instance, upon the First Fit; and yet, upon Recovery of his Senses, to complain of little or no Pain from such Dilaceration, when even the Bite of an Insect upon the Surface of the Body is attended with so much.

The Adhesion of this Man's Lungs explained likewise the Cause of his frequent Coughing for some Years before his Death.

XIV. *An Account of several Meteors, communicated in a Letter from Thomas Short, M. D. to the President.*

Sheffield, March

18. 1740-1.

Honoured S I R,

IF this Account of the following Meteors can either be of Use or Entertainment to the Members of your most Learned and August SOCIETY, I shall be glad. I am,

Honoured S I R,

Your most obliged,

obedient humble Servant,

Thomas Short.

THE Whole of 1737. having been the most irregularly constitute Year of any in my Time; not one Month but what had the Weather of all the Seasons in it, and that not by gradual Transitions, but by sudden Jerks; Summer was dry, *August* was as cold as Winter, *September* full of great Changes; hence that sudden and general *Catarrh* in *October*; succeeded in the latter End of the Month, and all *November*, by a fatal *Diarrhœa* among the Poor. From *November* 29. to *December* 5. was mild and warm, cloudy and clear mixt, like Spring Weather; the Wind daily veering from South to North-west, and every Night falling back to South-west or South. *December* 5. at Five o'Clock at Night, the Sky
round

round the Horizon was very cloudy, and clear in the *Zenith*; the West Quarter was all of a deep Blood-red Colour, with Streamers of a very beautiful light red, not running or dancing with sudden Occursions and Mixtures, like the *Aurora Boreales*, but waving like Vapours, toward the *Zenith*, by North-west to North: All the Clouds in the interim were of a very dark red Colour, except that in the West, which was of a deep Blood-red. After it had continued some time there, the same appeared in the North. Under the Clouds, from whence these Streamers came, was a Brightness superior to that of a Full Moon. Then both North and West sent forth their Blood-like Streamers, one toward the other, which passed one another, and came to their opposite Funds before they were quite spent. Between Seven and Eight at Night, the Scene shifted East; then that in the West was exhausted, and that in the North weakened: None of them sent their Streamers beyond the *Zenith* to the South; only the Clouds in the South were of a very opaque Red. Lastly, it removed South-east, where the Remainder was spent: All was over about half an Hour after Ten. I had no Instrument to take its Altitude.

The chief Remarkables of this Meteor were,

1. From whatever Quarter these Streamers came, they issued out of a thick, deep-red Cloud, under which was hid so luminous a Body, that I could have easily read on a large Church Bible.

2. These Streamers differed from those of all preceding *Aurora Boreales*: 1. That they were not white and clear, but a bright Red, like the Surface of

ar-

arterial or pulmonary Blood. 2. They were not small or narrow, but broad like the milky Way in a frosty Night. 3. They did not dart or fly swiftly from the Fund, or luminous Cloud, but moved slowly; then stood still some Space of Time; then sent out thin red Vapours, through which the Sky and Stars were visible; these quickly spent themselves, and vanished. 4. Not only were their Funds red, but the whole Clouds were thick, and of a deep fiery Red.

3. They were above the Region of the Winds; for, though the last was South-west, yet they moved from North to West, as quickly as from West to North.

4. Whilst the Sky on the *Zenith* was of the common azure Blue, that in the South, on the Opening of the Clouds, was a deep bluish Green, like Grass.

5. The whole Time was attended with an extraordinary Heat of the Air for the Season; for I was obliged to strip to the Shirt, though abroad in the Air all the time.

6. This Meteor was seen at *Venice* at the same time; and, over *Kilkenny* in *Ireland*, it appeared like a great Ball of Fire; which burst with an Explosion that shook great Part of the Island, and set the whole Hemisphere on Fire; which burnt most furiously, till all the sulphureous Matter was spent.

7. This Meteor put an End to the Remains of both the *Catarrh*, and watery *Diarrhoea*; and restored general Health, till the next epidemic *Catarrh* among Infants in *February* 1738. Two Months after.

The next Meteor was on *August* . 1733. a clear, calm, excessive hot Day, at Nine at Night, a frightful Glade of Fire, or *Draco Volans*, from East to West.

October 1. 1736. Day cloudy, Wind SW. clear Evening, Six at Night, fell a great Ball of Fire out of the Air to the Earth, no Rain 15 Days before, and only a few Drops Two Days after.

August 28. 1738. Five *p. m.* Wind SW. Sky clear, the Sun bright shining, a fiery Meteor appeared NE. ran North, like a Spear of Fire, with a great round Head, which burst like a Rocket, spread about in a large Fire, and vanished suddenly. This was a great Drought, which continued without Rain to *September* 7.

The next was *December* 2. 1739. Six at Night, Wind North, Sky clear, a white Frost, a great *Halo* about the Moon. This Meteor appeared like a large round Body of Fire, of about a Foot and a half Diameter; seemed very low, therefore could not be observed far, though it went all over this Country from North to South, pretty sharply, but nothing near so quick as a Glade of Lightning, was succeeded instantly by a most dismal Sound in the Air, like Carts, Drums, and Groans mixt: It kept the Tract of the Meteor, but in an opposite Course, *viz.* from South to West. This was a most frightful Time of Rains, Snow, Storms, &c.

As to *Auroræ Boreales*, the most remarkable were,
1. That of *September* 14. 1736. Wind North-west, Sky clear, next Day very rainy. This exactly resembled a Crown nobly adorned with the richest Jewels; its concave Side facing the West, and its convex reaching near the *Zenith*.

2. *September* 3. 1737. Wind NW. the Day was very rainy, and the Night a clear Frost. About One in the Morning, was another *Aurora Borealis*, like a Crown,
its

its concave Side full of Streamers, several times red, had very swift Motions; but the splendid Crowns stood steady and fair Two or Three Hours. We find an Instance of the like over *Bohemia* in the *Philosophical Transactions*.

The common late *Auroræ* were, 1736. *October* 16, 17, 18. Wind South, all Three Days showery, the Nights bright and clear. *March* 10. 1737. Wind West a Day and Rain, South at Night and clear. *September* 16. Wind West, clear Night. 17. Wind West, a Shower in the Day, and clear at Night. 19. 20. 21. Wind West, all fair, some little Frost. *October* 13, 14. Wind North, clear Days, frosty Nights; the 15th was much Rain. *March* 7. 1738. Wind South-west, Streamers reddish, Day cold and cloudy; the 8th was rainy; 30th, Air temperate, Wind NW. Day drizzling, next Day fair and clear. *February* 4. 1739. Wind North-west, Day and Night clear; next Day snowy; 23, 24. both Days clear, Wind West; the next Day good. *March* 1. Wind West; that Night frosty, the next after clear and good. *September* 13, 14, 15. Wind North-west in the Morning, and South-west by South at Night; all Three Days showery or drizzling, Nights clear; 18, 19. Wind East, cloudy fair Days. *October* 22. at Night, Wind North, cloudy; appeared a frightful fiery Dragon, seen over all *England*. This Month was the only good Weather from the 6th Day to the End, that this Country had that Harvest. *November* 25. Wind North-west, cloudy Day, with a Shower, clear frosty Night, with *Auroræ Boreales*. The next I saw was on *October* 6. 1740. Wind West North-west-by-west; Day clear, a small Shower, a frosty Night. *February* 28. 1741. Wind North-west.

. M m m m 2

March

March 5. Wind South. 6th, Wind West, then North.
9th, Wind South: All droughty Weather with small
Frosts.

To these Meteors I might add our Hurricanes,
Storms of Thunder and Lightning, with Hail or
Rain; but such as keep Journals of the Weather, and
read the public News, are no Strangers to these:
I shall only add, that our Northern Lights have been
much seldomer, and fainter, both in Appearance and
Motion, than formerly; and whether they will
dwindle away and vanish wholly for some Years, or
whether they have had their former periodic Returns,
is not certain: Nor is it less dubious, whether they
affect our Weather, Seasons, and Animal Bodies, or
not. Were it not too tedious, I might here subjoin
a List of all the Chasms or Burnings in the Heavens,
recorded in our Annals.

XV. Mercurius a Venere *sublatus* Maii 17.
1737. Grenovici in *Observatorio Regio*
observatus, per J. Bevis, M. D.

Horolog. Syder.—Horolog. Solare.

4.	20.	21.	—	z	.	z	Limbus Solis præcedens
							Merid. transit.
22.	37.	—		z	.	z	Sequens limbus transit.
34.	00.	—	0.	13.	25.		
35.	00.	—	0.	14.	25.		
5.	58.	48.	—	z	.	z	Limbus præcedens Ve-
							neris meridian. transit.
							Centro a vertice di-
							stan. { 25. 46. 30. }
							{ 25. 46. 41. }
							Mer-
							curium

Horolog. Syder.—Horolog. Solare.

curium vero intra telescopium nequaquam conspiciebam.

5. 58. 48.—9. 5. 5. Mercurii centrum præcedentem Veneris limbum præibat 12". temporis, in recta ascensione tubo 24 ped. micro-metro instructo.

—9. 7. 16. Repet. eodem tempore quo prius præibat.

—9. 28. 0. Mercurio filum Micro-metri parallelum decurrente, cuspis austrina Veneris ab eodem filo abscinditur



unde Venerem obtecuram Mercurium, vel saltem stricturam conjiciebam : micrometrum itaque extrahebam, quo melius instantem contactum discernerem.

9. 44. 0. Mercurius non plus distat a Venere quam decima parte diametri Veneris; deinde inimicæ nubes.

9. 52. 6. Venus nitori proprio restituitur; Mercurius vero totus sub Venere later. Nubes deinde Venerem
rursus

rursus excipiunt, ulteri-
orem tam rari phænomeni
contemplationem prohibentes.

J. Bevis.

Maii 18. Grenovici.

Horol. Syder. — Horol. Solare.

4. 24. 25. — : : :

Limb. ☉ præced. merid.
transf. inferiori dist. a ver-
tice 30. 4. 0.

26. 42. — : : :

Limb. sequens transit.

4. 38. 0. — 0. 12. 50.

4. 39. 0. — 0. 13. 50.

5. 57. 42. — : : :

Limb. præcedens ☿ transf.
merid. centro a vertice
distant. $\left\{ \begin{array}{l} 25. 57. 15. \\ 25. 57. 12. \end{array} \right\}$

Mercurium neque hac die
videre licuit, cœlo licet
admodum fereno.

XVI. *An Occultation of Aldebaran by the
Moon, Dec. 12. 1738. p. m. observed in
Fleetstreet with a reflecting Telescope of 15
Inches in Length, by Mr. G. Graham, F.R.S.*

THE Occultation at . . . 5h. 27'. 6".
Emerged at . . . 5. 29. 59.
Duration . . . 1. 2. 53.

The Sun's Transit at Noon at 11h. 59'. 52". the
Clock gaining of the mean Solar Time about One
Second in a Day. . . XVII. *Ans*

XVII. *An Eclipse of the Sun, Dec. 19. 1739!*
in the Morning, observed by Mr. Short in
Surrey-street, with a reflecting Telescope of 16
Inches Focus, that magnified about 40 times.

THE Beginning could not be seen for Clouds
 about the Horizon.

About 35' after 8 o'Clock, there was an Opening,
 when the Sun seemed to be about 2 or 3 Digits
 eclipsed.

End was exactly observed at 9^h. 1'. 45". t. app.

XVIII. *An Eclipse of the Moon, Jan. 2. 1740.*
observed at Mr. Graham's House in Fleet-
street, by Mr. Short, with a reflecting Te-
lescope of Nine Inches Focus, that magnified
about 40 times.

Beginning about . . . 8^h. 25'. 0". t. app.
 Beginning of total Dark- }
 ness at 9. 31. 10.
 End of total Darkness . . . 11. 15. 20.
 End of the Eclipse at . . . 12. 22. 0.

N. B. The Beginning and End could not be di-
 stinctly seen for Clouds.

XIX. *Some*

XIX. *Some Things concerning Electricity, by
the Rev. J. T. Desaguliers, LL. D. F. R. S.*

ABOUT a Year or Two ago, in a Paper I gave in to the ROYAL SOCIETY*, I endeavoured to establish some general Principles concerning Electricity, from the Consideration of many Experiments, which have been tried by others, as well as some new Experiments by myself, an Account of which I then gave. Therefore I shall only now repeat my Distinction of all Bodies into Two Classes, in respect of Electricity, and make good the Definitions that I gave by some further Experiments; and though I do not pretend to know the Cause of Electricity in general, yet I hope from a few Laws of Electricity, deduced from known *Phænomena*, to solve most other *Phænomena*, (tho' seeming quite unaccountable) so far as to shew what Law of Electricity they depend upon; and to be able to foretel what will happen to most Bodies, before the Experiments are tried upon them in an Electrical Way.

1. Bodies Electric *per se* are such in whom a Virtue of attracting and repelling small Bodies at a Distance is inherent, though it is not always in Action, so as to produce that Effect. But by rubbing, patting with the Hand, hammering, warming, and sometimes only exposing to dry Air, such Bodies exert the Virtue above-mentioned; otherwise they are in a Non-electric State.

2. Non-electric Bodies are such in which no Electrical Virtue can be excited by any Action upon the

* See these *Transactions*, N^o 454.

Bodies themselves, such as rubbing, warming, &c. But an Electric *per se*, when excited, can communicate its Virtue to a Non-electric, and that Virtue will be received by all the Parts of the Non-electric, (be the Body ever so long, or large) and be strongest, being, as it were, collected, at that End of the Non-electric, which is farthest from the Place where the Electricity is first received.

3. A Non-electric, having received Electricity, will communicate to another Body brought to touch it, or only brought pretty near, and that often with a snapping Noise, and a small Flash of Light, losing by that means all its own Electricity.

4. An Electric *per se* will become a Non-electric for a time, if it be made wet or moist, and become receptive of Electricity, which it will receive at one End, and carry to the other, where the Electricity will go off with a small Explosion, to impregnate any other Non-electric, which is brought near.

5. An Electric *per se*, in which Electricity has been excited, may become Non-electric by being exposed to moist Air, whose humid Vapours it attracts; and then, brought to the Fire, or into very dry Air, recover its Electricity when the Moisture is exhaled again.

6. An Electric *per se* may be made strongly electric in Part of its Length, whilst the other Part remains in a non-electric State.

7. A Body in a State of Electricity (whether a Non-electric having received Electricity, or an Electric *per se*, excited to Electricity) will attract all Non-electrics, and repel other Bodies that are in a State of Electricity, provided the Electricity be of the same kind.

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8. A

8. A non-electric Body will not retain the Electricity which it receives from an Electric *per se*, unless it be free from touching any other non-electric Body; but must be suspended or supported by Electrics *per se* touching only them and the Air.

9. An Electric *per se*, when it is not reduced to a non-electric State, will not receive Electricity from another Electric *per se*, whose Electricity is excited, so as to run along its whole Length; but will only receive it a little Way, being (as it were) saturated with it.

10. An Electric *per se* will not lose all its Electricity at once, but only the Electricity of such Parts of the Body as have communicated it to other Bodies, or near which Non-electrics have been brought.

11. When a Non-electric, which has received Electricity, communicates its Electricity to another, it loses all its Electricity at once; and the *Effluvia*, in coming out, strike the new Body brought near, as well as the Body first made electric.

12. Excited Electricity exerts itself in a Sphere round the Electric *per se*; or rather a Cylinder, if the Body be cylindric.

13. The Electricity which a Non-electric of great Length (for Example, a hempen String 800 or 900 Feet long) receives, runs from one End to the other in a Sphere of electrical *Effluvia*. But all the Supports of this String must be Electrics *per se*.

14. If this String be branched out into many Strings, the Electricity will run to all their Ends.

15. If the non-electric String, which is to receive and carry on the electric *Effluvia*, be not continuous, but has between its Ends some Electrics *per se*, the
Effluvia

Effluvia will stop at the first of them, unless the Interruption or Discontinuation of the Non-electric be short; because in that Case the Electricity jumps from the End of the first Non-electric to the Beginning of the next, especially if the Air be very dry, even though the Ends of the String should be about a Foot distant, and no Body but the Air between. Sometimes indeed the Distance must not be above an Inch or two.

There are Two Sorts of Electrics *per se*, known by what follows: A Body impregnated with Electricity from one Sort will repel all Bodies that have that Sort of Electricity, till they have lost their own Electricity by coming to some Non electric. But an Electric *per se* of the other Sort, though excited, will attract all those Bodies, though in a State of Repulsion on account of the other Electricity; and so *vice versa*.

XX. *An Account of some Electrical Experiments made before the ROYAL SOCIETY, on Thursday the 22d of January 1740-1. by the Same.*

IT being a Matter in Dispute, whether there is any Difference between the Electricity of Glass, and that of Gums and Resins, I made the following Experiments, in order to settle that Point:

I fastened a String of dry Cat-gut (which, when dry, is an Electric *per se*) from one Pillar to the other, at the End of the Table in the Meeting-Room of the

ROYAL SOCIETY, about Seven Feet from the Floor; and to the Middle of that Cat-gut fastened a silken Thread about Two Foot long, which hung down, and at its lower End had a Down Feather. Then rubbing the End of a Stick of Wax pretty quick and strongly against my Waistcoat, which was made of Cloth, the Wax became electrical, and attracted the Feather, which stuck to it awhile, and then was repelled from it, as long as it retained the Electricity it had received from the Wax: But, having touched the Feather with my Finger, it lost its Electricity; and, becoming a Non-electric, was again attracted by the Wax, which gave it fresh Electricity; and then it was repelled from it, and so *toties quoties*. When the Feather was in its electric State, I applied to it another Stick of Wax, which I first rubbed; and it repelled the Feather, though it had not touched it before, and did the same as the other Stick of Wax had done.

After that I rubbed a glass Tube, which first attracted and then repelled the Feather, as the Wax had done: And another Tube, being rubbed, repelled the Feather, when it was put into an electric State by the first Tube, without first attracting it. But Non-electrics, such as the Finger, or a Stick, attracted the Feather, when it had first been made electric; and not only so, but Electrics *per se*, when they were become non-electric, as the Tube unrubbed, or the Wax unrubbed; nay, the rubbed Tube also, when its End was moistened, or that End of it turned to the Feather, which had been held in the Hand.

Then I made the Feather electric, by the Application of the excited Tube; and, having rubbed the
Wax

Wax to give it Electricity, I brought it near the Feather, which it attracted strongly, though it had repelled it before, when the Feather had been made electric by Wax.

Afterwards I made the Feather electric by the Wax, which first attracted and then repelled it: And, having applied the rubbed Tube to the Feather, it attracted it strongly, though it repelled it when the Feather was made electric by another glass Tube.

XXI. Electrical Experiments *made before the*
 ROYAL SOCIETY, *on Thursday, March*
15th 1740-1. by the Same.

HAVING shewn lately by some plain Experiments, that the Electricity of Glass is different from that of Sealing-wax; because the Wax attracted a Feather suspended in the Air by a fine Silk, when the rubbed glass Tube repelled it, (as described in the Account of those Experiments) I made the Experiment with a Cake of Rosin instead of Sealing-wax; and it appeared to have the same kind of Electricity as the Sealing-wax. Then considering that the Supporters of any non-electric Conductors of Electricity must themselves be electric, I had a mind to try whether Bodies, endued with either kind of Electricity, were in any-wise different in that Case; which I did by the following Experiments:

I laid a Piece of Wood, Four Foot long, on Two glass Plates, whose Ends stood One Foot beyond the Side of the Table on which they were laid: Then,
 ap-

applying the rubbed Tube to one End of the Wood, the other attracted Leaf-brass, or a Thread hanging down from a Stick. Then, instead of the glass Plates, I laid the long Piece of Wood on Two Cakes of Rosin, and applied the rubbed Tube to the End of the said Wood, which conducted the Electricity to the other End, where Leaf brass and the Thread were attracted in the same Manner.

This shews that, in order to conduct Electricity along any non-electric Body, it is indifferent what Kind of Electricity its Supporters are endowed with, provided they are electric.

XXII. *A Letter from John Huxham, M. D. F. R. S. to C. Mortimer, M. D. Sec. R. S. concerning an Extraordinary Hernia Inguinalis; and an Observation of the Passage of Mercury over the Sun, Oct. 31. 1738.*

Honoured S I R,

AS the frequent Dissection of morbid Bodies tends greatly to ascertain the Diagnostic and Prognostic of Diseases, during my Studies, and for the first Six or Eight Years of my Practice, I applied myself to it with great Assiduity.—Some few of the more remarkable Cases, I have met with, I beg Leave to send you from time to time; and, if any of them appear to you worthy of that Honour, you may lay them before the ROYAL SOCIETY.—The following
may

may be of some Use in Practice : Therefore I send it first.

Mr. *Burman*, a Taylor of this Town, about 40, had from his Childhood laboured under a small inguinal Rupture on the Right Side; but about Six Years before his Death, from a Blow received in his Groin, the *Hernia* became very large, and the Gut always remained down in the *Scrotum*; for he wore no Bag, Truss, or the like, to support it.—The Day before his Death, he was following his Work, as usual, with his Pressing-iron, without any violent Jerk, or Straining; but, about 10 in the Morning, all at once, he felt a very great Pain in his Right *Inguen*; which, continually increasing, in Two or Three Hours threw him into Vomitings, cold Sweats, &c. —His Apothecary, Mr. *Ellery*, gave him a Clyster, which brought off a small matter of thin Stool; but gave no Relief, though it had been formerly very serviceable to him in the like Disorder.—About Eight in the Evening I was sent for, and found him in cold Sweats, with scarce any Pulse: The *hernial* Tumour was prodigious large, and exceeding hard; the Pains extremely violent, which caused excessive Languors.—I immediately ordered, that he should be placed in a proper Posture, that a warm aromatic emollient Fomentation should be frequently and long applied, and that a Reduction of the Intestine should be attempted; or, if that did not succeed, that the Operation for the *Bubonocoele* should be performed. —The Fomentation was tried a long while, emollient *Terebinthinate* Clysters injected, and the Reduction attempted, for an Hour or Two, by Mr. *John Start*, a skilful Surgeon, but in vain: Nay, the Swelling

ling increased considerably during the Application; and the Pain became (if possible) more aggravated all over the *Hernia*, which before was chiefly at, and near, the Rings of the *Abdominal* Muscles; and this too, though he took, with an easy Cordial, and mulled Wine, *Laudan. Solid. gr. ij 3iis Horis*.—Early the next Morning I was desired to see him again; and, finding that he had not slept a Moment, the Tumour considerably increased, and excessive hard, though not discoloured, and the Patient exceeding weak and pained, I advised the Operation forthwith, as the only possible Means of saving him: But he was unwilling to admit of it, and we were all indeed diffident of the Success.—Whilst a fresh Fomentation was getting ready, the poor Man expired in Agonies.—About an Hour or Two after, we opened the *Scrotum*, which in so short a Space of Time appeared all livid, and the Blood-vessels were extremely turgid and varicose.—Upon cutting through the Teguments, Part of the *Colon* and *Ilium* thrust out with great Force; they were both prodigiously distended with Wind, highly inflamed, and in several Places very livid.—That Part of the Guts commonly called *Cæcum*, was blown up into a kind of globular Figure, as big as a Child's Head.—It was remarkable, whether in the original Conformation, or by the vast Distention, I know not, that there was no manner of Appearance of the *Appendix vermiformis* to be found, though we diligently examined:—And further, that the *Cæcum* was vastly thicker set with Glands, and they much larger, than I had ever seen before in any Subject.—The Convolutions of the *Ilium* and *Colon* were so immensely distended with
Wind,

Wind, that the valvular Corrugations in both almost totally disappeared.—Yet exactly at the *Valvula Tulpii, alias Bauhini*, there was a very great Constriction of the intestinal Canal, as if tied strongly with a Cord; and, though we opened the *Colon* about a Hand's-breadth beyond the *Valve*, and let out the *Flatus*, we could not possibly press any Wind from the *Ilium* into the *Colon* through the *Valve*.—I suspected indurated Excrement, as an Obstacle; but, on a careful Inquiry, only found the whole valvular Production, and the End of the *Ilium*, at its Insertion into the *Colon*, highly inflamed, and quite shutting up the Passage.—On dilating the Rings of the oblique and transverse Muscles, the Wind rumbled up out of the *Ilium* into the Cavity of the Belly very readily.—We found pretty much bloody *Sanies* in the Guts, on slitting them open, but little or no indurated *Fæces*: A manifest Proof, that the exceeding Hardness of the Tumour was owing only to the excessive Flatulence, and great Inflammation; and shews how much we may be deceived in our Conjecture on like Occasions.—The Tumour of the *Scrotum* was 28 Inches round.—I was much surprised to find no Adhesion of the *Intestines* to the containing Parts, though he had so long laboured under the *Hernia*.

This unhappy Case gave me a severe Reflection, and I cannot but think the Malady was much increased by the repeated Application of the hot Fomentations; as it rarefied the Air greatly, and, by relaxing the Parts, gave further Room to the vast Expansion.—At that time I had never seen *Belloste's* Second Part to his *Hospital-Surgeon*, where he advises, in

such Cases, the most cold astringent Fomentations. —In this and the like, they might have been very proper; especially if a Portion of Spirit of Wine camphorated had been added to prevent Mortification.

It sometimes happens, that though the annular Perforations of the abdominal Muscles are dilated by the Operation, yet the *Hernia* cannot be reduced. — I believe, as the Guts were distended to so enormous a Bulk in this Man, it would have been impracticable. In such Cases may it not be proper to prick them with a Needle, to let out the *Flatus*, as is commonly practised in small Wounds of the *Abdomen*, where the *Intestine* thrusts out, and becomes so turgid with Wind, that it cannot otherwise be returned? — In some ventral Ruptures (as they are called) this also may be necessary. — I find Mr. *Sharp*, in his late excellent Piece of Surgery, approves of this Method, from an old *English* Practitioner, who had often used it with Success. — I am persuaded, Punctures in this Manner are much less dangerous than the Operation; and believe, in such Cases, may be more effectual. — It is a common thing with Grasers and Cattle-Doctors, to prick the Guts of their Sheep and Bullocks with great Success, when, by feeding on Clover, or fresh young Grass, their Guts become so vastly distended with Wind, as would otherwise certainly kill them. — May not a very small hollow Needle with Perforations, as in that used by some instead of the *Trocar* for a *Paracentesis*, be more proper than a common Needle? — May not the hernial Tumour be perceived to be chiefly flatulent by its being in
some

some Degree transparent upon applying a Candle, as used in the *Hydrocele*? And may not that direct the proper Place for Punctures?

These are Conjectures; but I am, with great Truth, and the highest Respect,

S I R,

Your most obliged,

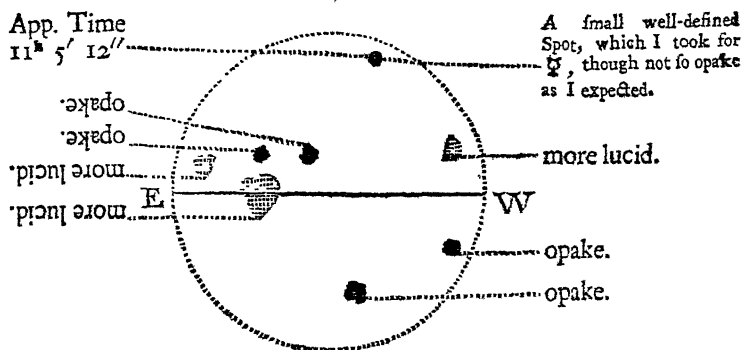
Plymouth, June 8. 1739.

and most obedient,

humble Servant,

J. Huxham.

I have taken the Liberty to fill up this Letter with a Scheme of the Phase of the Sun, *October* 3rd, 11h. 5'. 12". as taken by my Telescope, which is a very good one of 10 Feet; but as I had neither Cross-Hairs, Micrometer, or other exact Instruments, the Observation may not be very exact: Besides, I had only a Glimpse of the Sun for 7 or 8 Minutes.



XXIII. *An Observation on the Planet Venus,*
(with regard to her having a Satellite)
made by Mr. James Short, F. R. S. at Sun-
rise, October 23. 1740.

Directing a reflecting Telescope of 16.5 Inches Focus, (with an Apparatus to follow the diurnal Motion) towards *Venus*, I perceived a small Star pretty nigh her; upon which I took another Telescope of the same focal Distance, which magnified about 50 or 60 times, and which was fitted with a Micro-meter, in order to measure its Distance from *Venus*; and found its Distance to be about $10^{\circ}. 2'. 0''$. Finding *Venus* very distinct, and consequently the Air very clear, I put on a magnifying Power of 240 times, and, to my great Surprise, found this Star put on the same Phasis with *Venus*. I tried another magnifying Power of 140 times, and even then found the Star under the same Phasis. Its Diameter seemed about a Third, or somewhat less, of the Diameter of *Venus*; its Light was not so bright or vivid, but exceeding sharp and well defined. A Line, passing through the Centre of *Venus* and it, made an Angle with the Equator of about 18 or 20 Degrees.

I saw it for the Space of an Hour several times that Morning; but the Light of the Sun increasing, I lost it altogether about a Quarter of an Hour after Eight. I have looked for it every clear Morning since, but never had the good Fortune to see it again.

Cassini,

Cassini, in his Astronomy, mentions much such another Observation.

I likewise observed Two darkish Spots upon the Body of *Venus*; for the Air was exceeding clear and serene.

XXIV. *An Occultation of Jupiter and his Satellites by the Moon, October 28. 1740. in the Morning; observed at Mr. George Graham's, F. R. S. House in Fleetstreet, London, by Dr. Bevis and Mr. James Short, F. R. S.*

Times by Apparent
the Clock, Times.
October 26. October 27.

Clock above
Stairs.

h. ' " " "

23. 46. 38 0. 0.

Clock below.

14. 49. 4 15.

14. 52. 15. 5. 53

THE Sun's Centre
passed the Meridian
in the Transitory.

The Moon's illuminated
Limb preceded *Jupiter*
in Right Ascension 1'.
38". in time.

The same Limb preceded
Jupiter 1'. 31".

These were taken with
a reflecting Telescope,
9 Inches

9 Inches Focus, fitted
with Wires at half
Right Angles, and
which magnified 30
times.

Clock above

15. 26. 1. 15. 39. 20. *Sirius* passed the Meridian.

15. 37. 43. 15. 51. 2. The Moon's Centre passed
the Meridian.

15. 39. 9. 15. 52. 28. *Jupiter's* Centre passed the
Meridian.

Clock be-
low.

15. 41. 15. 15. 54. 36. *Jupiter's* Third *Satellite*
eclipsed by the Moon.

15. 47. 10. 16. 0. 31 *Jupiter's* Second *Satellite*
eclipsed by the Moon.

15. 53. 4. 16. 8. 25. *Jupiter's* preceding Limb
immersed.

15. 57. 20. 16. 10. 41. *Jupiter's* subsequent Limb
immersed.

16. 0. 54. 16. 14. 15. *Jupiter's* First *Satellite*
eclipsed by the Moon.

These Immersions were
taken with a Reflect-
ing Telescope, of 16.5
Inches Focus, that
magnified 120 times.

Clock above.

16. 17. 49. 16. 31. 8. *Procyon* passed the Meri-
October 27. *October* 28. dian.

23. 46. 42. 0. 0: 0. The Sun's Centre passed the
Meridian.

N. B. The Clock in the lower Room was all
along 2'' slower than the Clock in the upper Room.

None

None of the Emerfions could be feen for Clouds. Whilft *Jupiter* was immerging, the Sky was perfectly ferene; and, at his neareft Approach to the Moon, he did not appear to alter his Figure in the leaft, nor to be tinged with any prismatic Colours; neither did he (as is faid to have been fometimes obferved through refracting Telescopes) feem to enter at all upon the Moon's Body.

That Part on the Moon's Limb where *Jupiter* entered, was a Hollow; and though fome are of Opinion, that the Circumference of the Moon, as it is bounded to our Eye, is a perfectly fmooth Circle, and that no Hills or Hollows appear there, as on the Surface of the Moon; yet if it be looked at in a clear Night with a good Telescope, that magnifies about 100 times, or even lefs, it will be feen rugged and uneven all round.

Notwithstanding *Jupiter's* Light feems to be more vivid than that of the Moon, when he is feen at a good Distance from her, and far more fo when the Moon is away; yet the contrary is plainly difcerned when they are near one another: And in this Obfervation, whilft *Jupiter* was immerging behind the Moon, his Disk appeared much dimmer, and of a more faint and dusky Complexion, than the Disk of the Moon.

XXV. *A Letter from James Parsons, M. D. F. R. S. to the ROYAL SOCIETY, giving a short Account of his Book intituled A Mechanical Critical Inquiry into the Nature of Hermaphrodites. London, 1741. in 8^{vo}.*

GENTLEMEN,

AS the Compass of Nature is the utmost Boundary of any certain Knowledge we can arrive to in this Life, the Discovery of Truth by our Inquiries made into the Myſteries of Nature, muſt afford the greateſt Satisfaction.

Physical Knowledge ought much more to be the Subject of every one's Contemplation then, as yet, it ſeems to be; being moſt conducive to publick Welfare, and to furniſh the Minds of Men with the juſteſt Notions of the great AUTHOR of Nature: Elſe why do learned Societies ſo aſſiduouſly aſſemble? Why endeavour ſtill to add more Grains to their former Knowledge? but becauſe (alſo) the Study of Nature is the only pleaſing and ſmooth Field for the inquiſitive Soul to range in; a Field whoſe Objects are capable of being ſeized by our proper Senſes, and whoſe *Phænomena* may, by due Application, come within our Reaſon.

Such a Society then are the beſt Judges, and fitteſt Protectors, of every Eſſay oppoſed to vulgar Errors. 'Tis therefore I took the Liberty of dedicating this my Inquiry into the Nature of *Hermaphrodites* to you, which the Preſident, Vice-Preſident, and others
of

of you, were so kind to say, would not be unacceptable; especially as it was wrote at a Time when the Town was daily entertained with Advertisements of the *Angolan* that was shewed here publickly, and, thereby, was almost in general allured into the same Error that most of the Nations upon Earth had implicitly run after, from the Beginning of the World, concerning them; who were led into it by no less than the Writings of their most learned Men.

In order, Gentlemen, to give you, in some measure, a View of the Design of this little Book, I am to inform you, that the general Opinion of the World is, that there are *Hermaphrodites* in human Nature. In this Treatise I am to shew it cannot be; which I have endeavoured to do in the following Method, *viz.*

1. The Introduction, which is chiefly historical, lays down the Manner of this Error's being propagated amongst *Jews, Pagans, and Christians*, at all Times; with an Account of *Jewish*, Civil, and Canon Laws made against such as were reputed *Hermaphrodites*, as well as those that were always in Force at *Rome*, by which great Numbers of People were destroyed from time to time.

2. The First Chapter exhibits many Reasons against a Possibility of their Existence in human Nature; with a true Discovery of such Diseases as have been the Cause of Men and Womens being called *Hermaphrodites*.

3. The Second Chapter is a critical Account of the Causes Authors have assigned for the Produce of *Hermaphrodites*; wherein it is proved, that no such Effects could arise from those Causes; and several

Absurdities are exposed in the Arguments advanced for the Support of this Error.

4. The Third Chapter is a critical View of the Histories of *Hermaphrodites* given by several Authors; shewing that those so reputed were either perfect Men or Women, having only some Deformity or Disease in the Parts of Generation.

5. The Conclusion describes the State of all Female *Fætuses*, with some Observations which I laid before this most Honourable SOCIETY; which prove that every Female *Fætus* may as well be thought an *Hermaphrodite*, as any that were ever called so.

By this Method I hope it will appear, that this so long reigning Error is confuted; and if this Learned SOCIETY, whose sole Business here is to inspect into the true Nature of Things, think I have succeeded, and give this Treatise, which I have the Honour to present them, a favourable Reception, it will be esteemed a very great Honour by their

Most obedient Servant,

J. Parsons.

XXVI. *An Account of an antient Date in Arabian Figures, upon the North Front of the Parish Church of Rumsey in Hampshire.*
By the Rev. Mr. William Barlow.

AS the knowing how long the *Arabian* or *Indian* Figures have been used in the West, may sometimes be a means for distinguishing spurious from

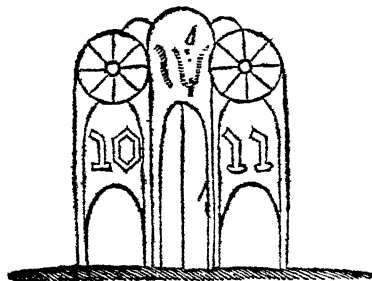
from genuine Dates; so a wrong Hypothesis—fixing the Time later than it ought to be—may possibly induce us to suspect genuine Dates to be doubtful or spurious. To give some Light to this Subject, I have here sent a Draught of Part of the North Front of the Abbey (now Parish) Church of *Rumsey*, in the County of *Southampton*, with an Inscription on the same. That this Inscription is a Date, 1011, is evident from the Figures. That it is a genuine Date, the apparent Antiquity of the Building plainly demonstrates. A spurious Date in this Place would have expressed the Time when the Abbey was founded by King *Edward*, Grandfather of *Edgar*, above a Hundred Years before the Time here mentioned.

There is something very remarkable with relation to the Time when this Church was built. Not only during the Year of this Date, 1011, but for several Years before, many Parts of *England* were laid waste by the revenging *Danes*, justly incensed against the *English* by the inhuman Massacre of their Countrymen in the Year 1002. The *Saxon Chronicle*, p. 141. acquaints us, that the County of *Hants*, *hamtun-rycpe*, among others, was miserably harrassed by these cruel Invaders this Year of the Date *. It is therefore very extraordinary, that so fine a Pile (according to the Age when it was built) should be raised at a time when every thing else, Sacred and Civil, was plundered and destroyed by these merciless Ravagers. But probably the Devastation was not quite so general as represented.

* Florence of Worcester also observes the same. . . *Suthamptonensi, Wiltunensi . . . provinciis . à Danorum exercitu ferro flammaque demolitis. Ad An. 1011. p. 613.*

If this be a genuine Date, (and I see no Reason to question it) it is, I believe, the antientest, *Indian*, or other, that has yet been taken notice of in *England*, perhaps in *Europe*; and quite destroys the Opinions advanced by *Scaliger*, *Vossius*, *F. Mabillon*, *Dr. Wallis*, and other learned Men, concerning this Matter.

Now I have mentioned this Abbey of *Rumsey*, I take Leave to correct an Error in Sir *H. Savil's* (the only extant) Edition of *Roger Howeden*, *Frankf.* 1601. p. 426. *Anno 967. Rex . . Edgarus in Monasterio Ramefeie, quod Avus suus Edvardus senior construxerat.*—Here it is called *Ramefeie*, by Mistake, for *Rumeseie*; and again in the same Page. But *Ramefeie* was *Ramsey* in the County of *Huntington*, a Monastery founded by *Oswald** Bishop of *Worcester*, afterwards Archbishop of *York*, consecrated by the said *Oswald* *An. 991* †. This Identity of Name, unobserved, may occasion great Confusion in the History of these Two Places. I find *F. Cressy* (p. 860.) or the Authors he transcribed from, misled by this typographical Error. Possibly others may fall into the same Mistake, by the same Means. It is pity there is not a more correct Edition of that Author.



* *Will. Malmesb. De Gest. Reg. Ang. l. 56. 291.*

† *Simeon Dunelm. ad An. 991.*

XXVII. *Some Observations concerning the
Virtue of the Jelly of Black Currants, in
curing Inflammations in the Throat. By
Henry Baker, F. R. S.*

SINCE Providence has been pleased to bestow certain medicinal Virtues on many Animals, Vegetables, and Minerals, which, in particular Cases, may be highly serviceable to the Health of Mankind; when such Virtues are happily discovered, they should be made as generally known as possible, that all may partake the Benefit.

No farther Apology need be offered to this illustrious SOCIETY, for communicating a short Account of the speedy Relief myself and many others have frequently received, in a very troublesome and often dangerous Disorder, by the particular Virtue and Efficacy of a Shrub, well known amongst us, though commonly but little regarded.

From my Childhood, till within about Twelve Years past, I used, almost constantly, upon taking Cold, to be seized immediately with an Inflammation in the Throat, attended with great Swelling, Throbbing and Soreness: And notwithstanding Bleeding and Purging, together with the Assistance of Gargles, Linctus's, and all the other Methods generally made use of in such Cases, it most commonly would take its Course; that is, in about a Week or Ten Days time, it would suppurate and break, a considerable Quantity of fetid Matter would be discharged, and then I soon recovered.—During its Continuance, I
was

was unable to swallow any thing but warm Liquids, and even those not without much Difficulty and Pain; but upon its breaking I found immediate Ease.

This Disorder attacking me Five or Six times a Year, and sometimes oftener, afforded but too frequent Opportunities of experiencing, that all the common Methods did me no Good at all; but, on the contrary, made my Uneasiness last the longer, by retarding the Suppuration: Which often determined me to leave it wholly to Nature, with the Assistance only of warm Broths and Gruels.

But, about Twelve Years ago, I became acquainted with a learned and ingenious Clergyman, the Rev^d Mr. *Washbourne*, Vicar of *Edmonton*, and one of the Canons of *St. Paul's*; who told me, that from many Experiments on himself and others, scarce ever failing of Success, he could almost assure me of a certain Cure, if, as soon as ever I should perceive any Swelling or Soreness in the Throat begin, I would swallow, leisurely, a small Quantity of the Juice of *Black Currants* * made into a Jelly; or, if the Jelly could

* *Ribes nigrum*, Raii *Hist. Plant.* Vol. II. p. 1486. SQUINANCY BERRIES: *Anginæ utiles* [baccas] esse nomen Anglicum arguit.

Dale in *Pharmacologia Jua* in 4to. p. 293. (ait) *Ribes nigra* in *angina commendatur*.

John Aubrey, Esq; F. R. S. in his *Miscellanies*, printed at *London*, 1721. in 8vo. p. 63. says, that a Gentlewoman had her fore Throat cured by a Pultice of *Blue Currants*.

The Efficacy of the Jelly of *Black Currants*, in curing sore Throats, has been long known among several good Women, who give away Medicines in the Country; yet it has been hitherto so overlooked by Physicians, as not to be ordered to be kept in the Apothecaries Shops; and even the Rob or Jelly of *Elder-berries*, which comes up to this next in Virtue, although ordered, is kept but in few Shops. C. M.

not be got, a Decoction of the Leaves in Milk, or even of the Bark (if it should happen in Winter), used by the way of Gargle, would prove, he said, a Specific for all inflammatory Disorders of the Throat.

Though I had no great Faith, I resolved to try this easy Remedy: And, as soon as *Black Currants* could be got, caused a Quantity of their Jelly to be made: Nor was an Occasion of trying it long wanting, when, to my great Surprize and Joy, I found its Effect beyond any thing I could imagine; for in Two or Three Hours the Inflammation and Swelling intirely vanished, and my Throat remained as easy as if nothing at all had happened.

From that time till very lately, for a Dozen Years together, this Medicine has never failed me once: But has, on numberless Trials, taken away this Disorder from me in a few Hours. It has likewise had the same good Effect on many of my Friends, to whom I have at different times recommended it, so that several of them are never now without it in their Houses.

But a Disappointment I lately imagined I had met with from this Medicine, is the Reason of my laying before you the following Fact.

Upon taking Cold, about Ten Weeks ago, I was seized with an Inflammation in my Throat, attended with Soreness, and throbbing Pain; on which I applied to my old Remedy, but without the usual Success; for though I took it several times a Day, for Two or Three Days together, the Disorder grew continually worse, and the Left Side of my Throat was so violently inflamed and painful, and swelled to such a Degree, that I was not able to swallow even Liquids

quids without abundance of Trouble. In short, it exactly resembled the sore Throats I used to be afflicted with before my Knowledge of this Medicine; and therefore I gave it up to take the same Course it was accustomed to do formerly.

After about a Week, when I had good Reason to believe there was a considerable Collection of Matter, and I expected it every Hour to break, I was called by Business to a Relation's House at *Tottenham*, in *Middlesex*; where, being scarce able to get down a single Dish of Tea, my Friends (who have been long acquainted with the Virtues of *Black Currant Jelly*) inquired wherefore I had not applied to my usual Remedy: I told them, that I had, but to no purpose at all; which I knew not how to account for, unless, mine being above Two Years old, Time had destroyed its Virtue. They said, they had lately made some; and immediately fetched a Glass of it, which they persuaded me to make use of.—I took Three or Four Spoonfuls of it, rather through Civility, than from any Hope of its doing Good, at a time when I every Moment expected and wished it to break.

In about an Hour's time, as I sat by the Fire-side, I perceived a sort of disagreeable putrid Smell, which I did not mind at first, supposing it something accidental: But, finding a Continuance or rather an Increase of it, I began to examine what it might be owing to; and was convinced, after I had changed my Place, that it proceeded from myself, and was really the Smell of my own Perspiration, which I found so much increased, as to become almost a Sweat. At the same time, fancying my Throat a little easier, I took some more of the Jelly.

I came to *Tottenham* about Five in the Afternoon, and began with the Jelly about Six. At Supper I with some Difficulty got down a little Gruel; and when I went to-bed, drank some Linseed-tea, sweetened with Syrup of Mulberries.—I soon got to sleep; but, waking after some Hours, found myself in a gentle breathing Sweat, attended with the same unpleasant putrid Smell. The Swelling in my Throat was, however, sensibly diminished, and the Soreness much abated: At which being rejoiced, I took a Mouthful of the Jelly that stood by my Bedside, and composed myself to sleep again. A gentle Sweat continued during the whole Night; and, in the Morning, the Swelling, to my great Amazement, was quite reduced, and the Soreness so inconsiderable, that about Ten o’Clock I eat some Toast with Chocolate, and by Dinner-time had no more Remains of any Disorder than if it had never been.

I am very certain the Swelling was not discharged by breaking; for had it broke, even in my Sleep, I must have found some ill Taste in my Mouth at waking: Whereas I was not sensible of any disagreeable Taste at all, but the Smell before-mentioned was greatly offensive to me, whenever I put my Nose into the Bed.

During the whole Time I have been speaking of, that is, for about Seventeen Hours, I made Water but once only, and then in a small Quantity: The Colour of it was very high, and it soon threw down an exceeding thick Sediment, as did all I made for Two Days afterwards, though gradually clearing up more and more.

I shall not presume to offer any Opinion as to the Manner this Medicine operates, but leave it to be considered by more proper Judges; only permit me to observe, that were the Virtues of Simples diligently inquired into, we might perhaps discover more ready and certain Cures for some Distempers than what we know at present. The barbarous *Negroes*, merely by Trials and Observations, have been able to find out both Poisons and Counterpoisons, on which (if our Accounts of them be true) they can depend with Certainty: And we know, that the Savages in *America* have discovered by the same Means, and generously taught us, the medicinal Effects of their *Ipecacuanha*, *Contrayerva*, *Peruvian Bark*, and some other Simples, which are almost infallible in curing the Disorders of the Climate where they grow: Nor is it improbable, that every Country may produce Remedies for the Diseases of its Natives.

L O N D O N :

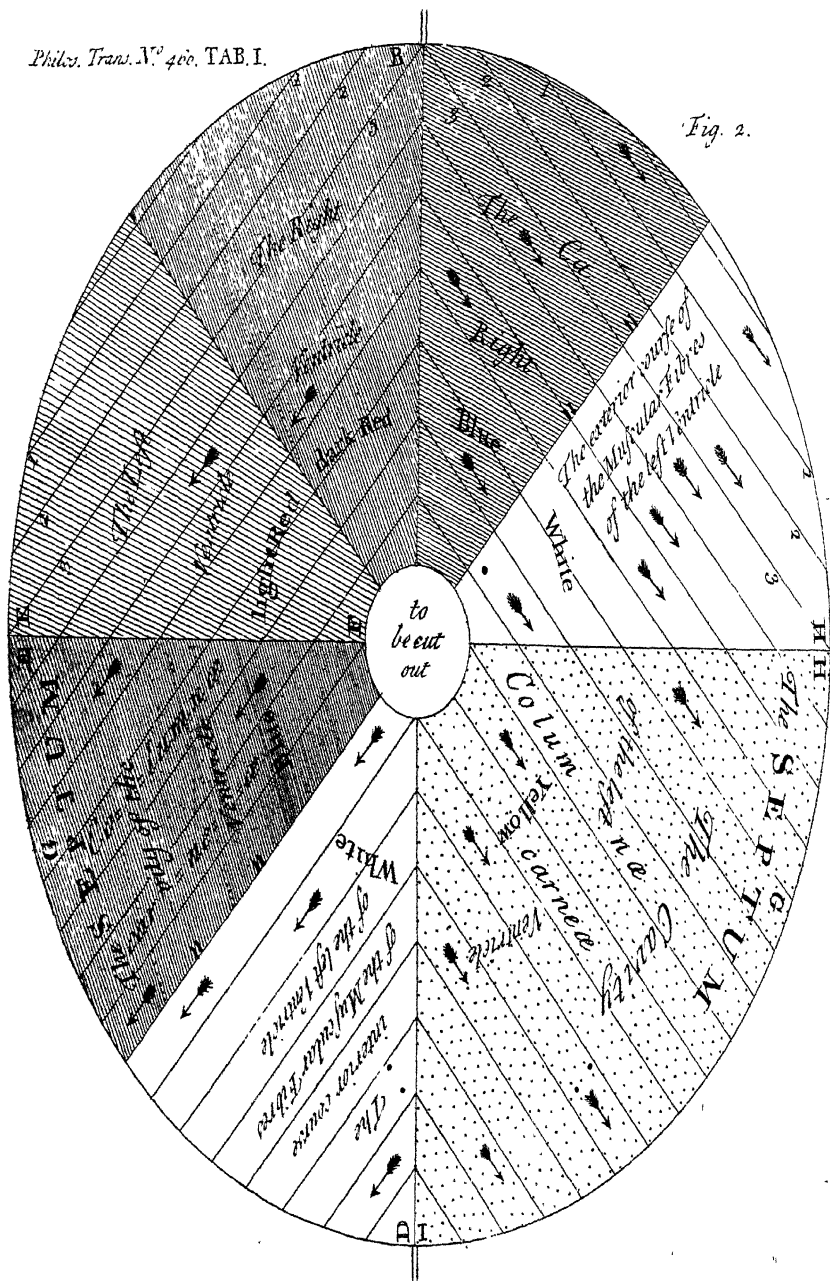
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N. B. Dr. *Jurin's* Dissertations were first printed thus :

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 2. 363.
 3. . . in *Comment. Acad. Petrop.* Tom. III. p. 281.
 4. . . in *Transactions*, N^o 355.
 5. 373.
 6. 358, 359.
 7. 362.
 8. 361.
 9. . . at the End of the 8 preceding, under the Title of

Dissertationes Physico-Mathematicæ, Auctore Jacobo Jurin, M. D.
 Lond. 1732. 8°. See Page 607.

Fig. 2.

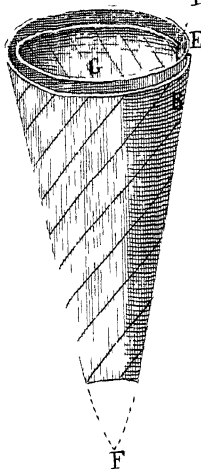


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Fig. 1

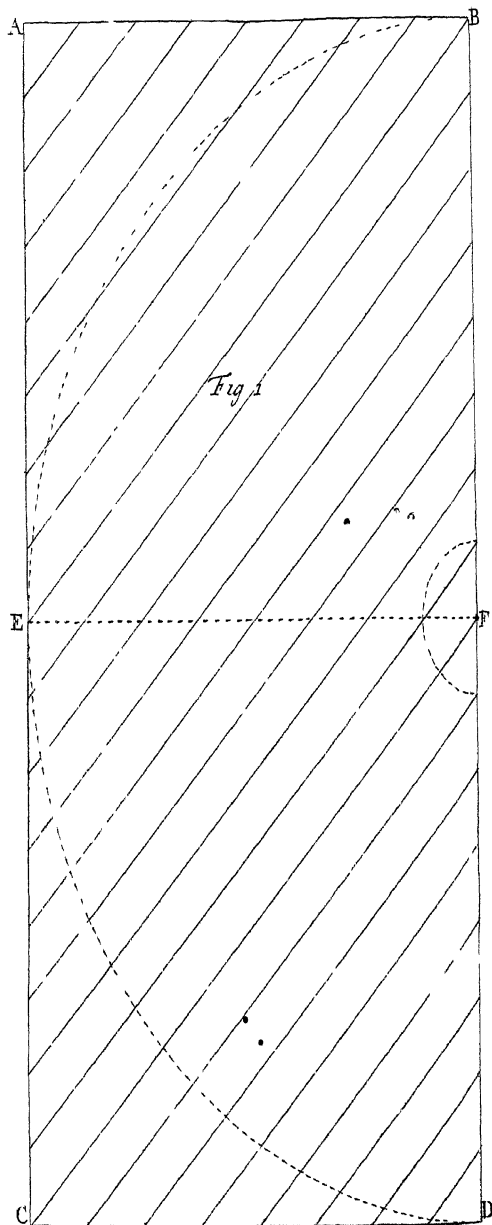
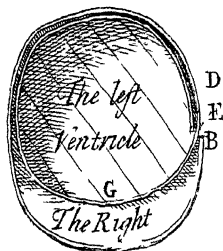
TAB I

D



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Fig. 4



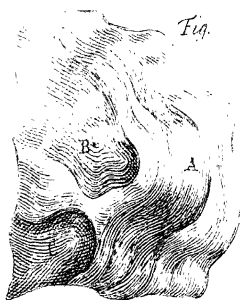


Fig.

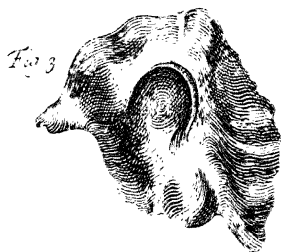


Fig. 3

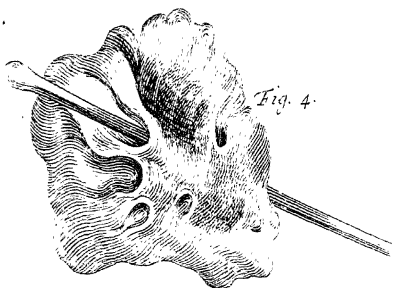


Fig. 4.

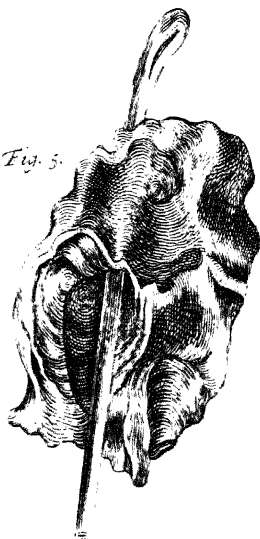


Fig. 5.

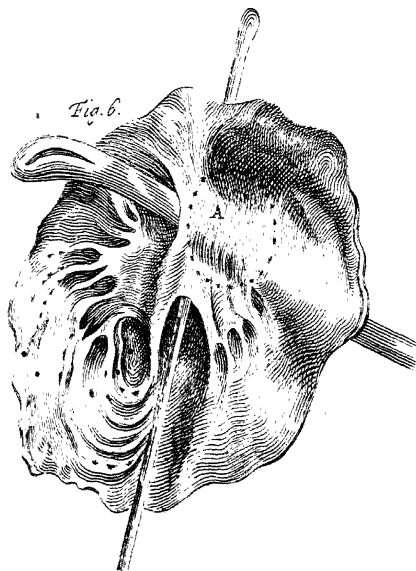


Fig. 6.

A Scale of Inches.

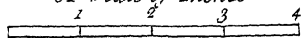


Fig. 2.

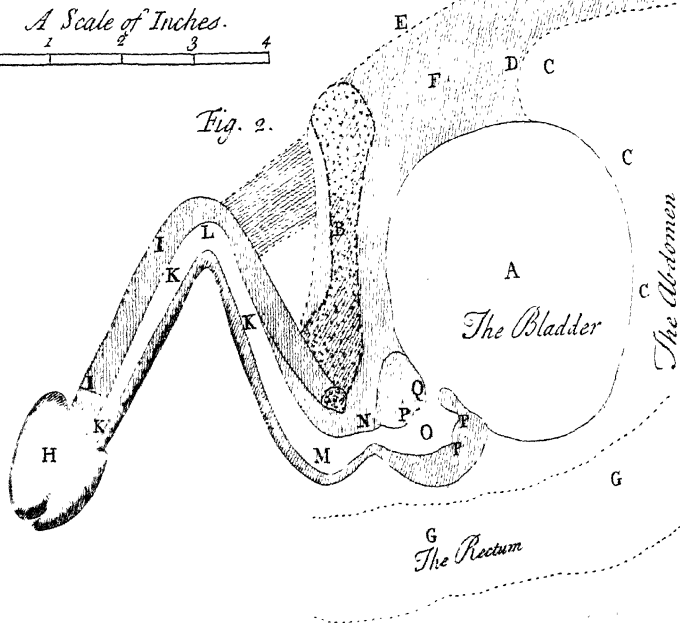


Fig. 1.

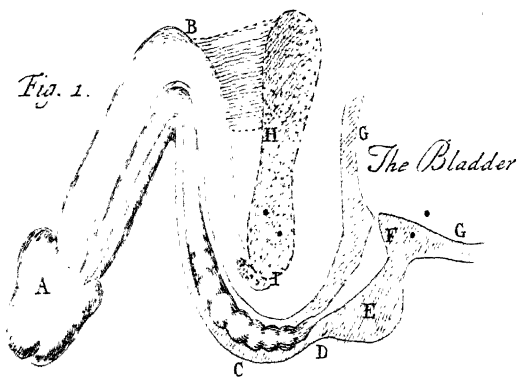


Fig 1

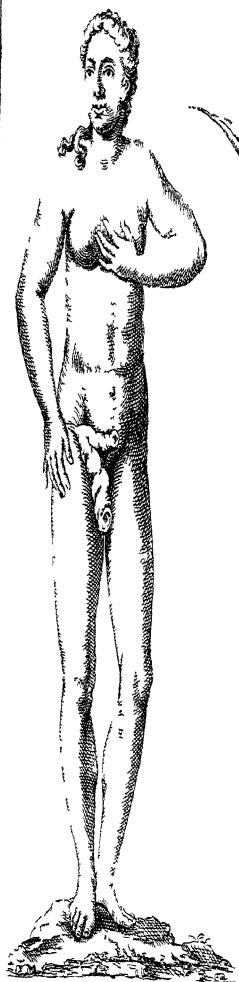


Fig 2

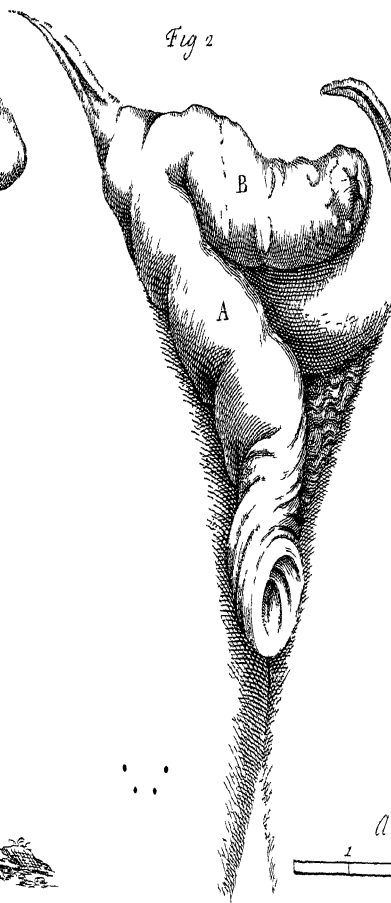
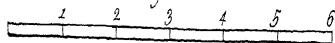


Fig 3



A Scale of 6 Inches

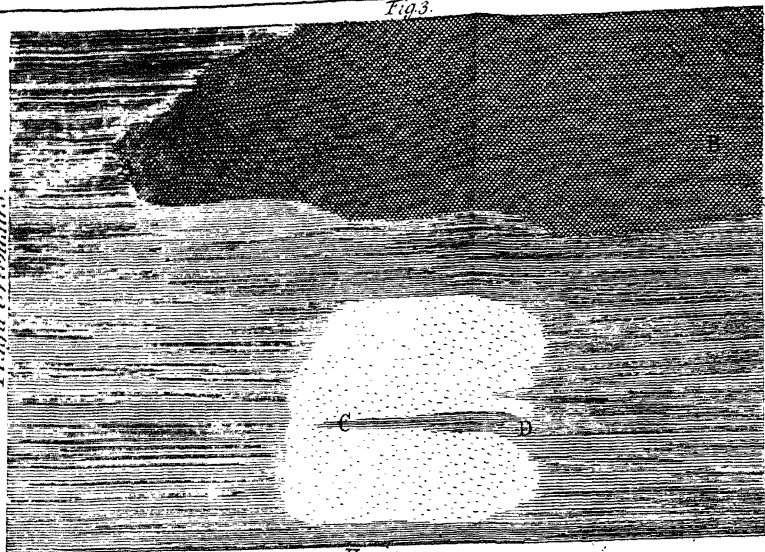


for Fig 2 & 3

Fig. 3.

Fluxa Crinoides.

Plaga Horizontalis.



Horizon.

Fig. 1.

Philos. Trans. N^o 460. TAB. VI.

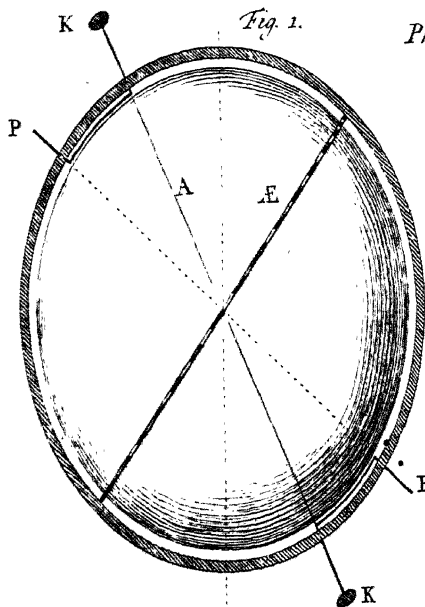
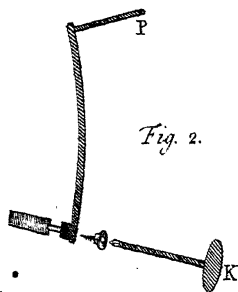
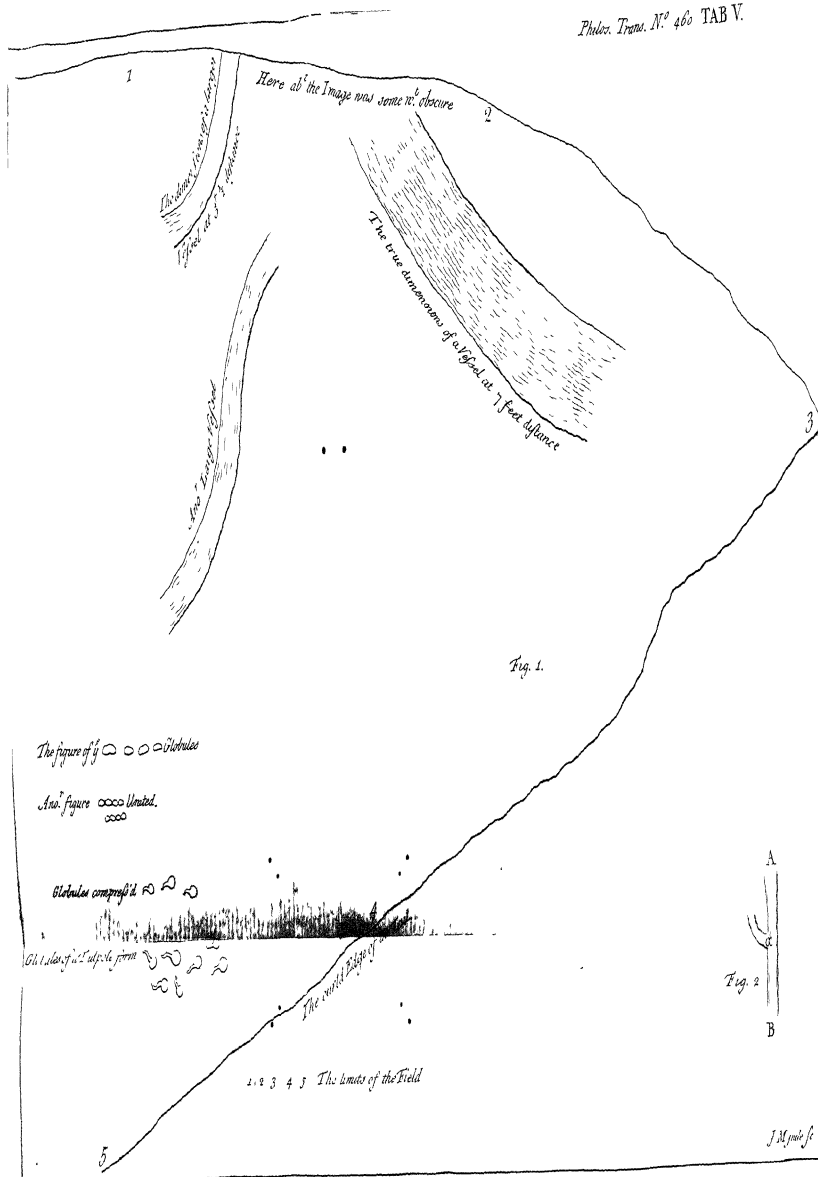


Fig. 2.



J. Mynde sc.



PHILOSOPHICAL TRANSACTIONS.

For the Months of *April, May, June and July,*
1741.

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I. *Several Electrical Experiments, made at various Times, before the ROYAL SOCIETY, by the Rev. J. T. Defaguliers, LL. D. F. R. S.*

1. *An Account of some Experiments made before the ROYAL SOCIETY, May the 14th, 1741.*

I Mentioned in one of my former Papers concerning Electricity, that Electrics *per se* would not receive the Electricity of a rubbed Tube, so as to carry on to a Distance; but that, if those Bodies were changed into Non-electrics, they would then receive and convey the Electricity of the rubbed Tube, in the same manner as all other Conductors of Electricity do. The Experiments which I made to prove this plainly, are as follow :

EXPERIMENT I.

I suspended a long small glass Tube at about the Distance of 14 or 15 Inches from an horizontal extended Cat-gut in the same Position, or parallel to it, by Two small silken Threads; and, with a small Packthread, hung an ivory Ball on the End of the suspended Tube; and, applying the rubbed Tube to the other End, (though lightly excited, as appeared by its snapping) no Electricity was communicated to the Ball : Though, when a very small Packthread was hung from one End of the Tube to the other, the ivory Ball became very electric, as appeared by its attracting a Thread hung on a Stick. Then taking off the Packthread, and wetting the Tube from one End to the other, with a Sponge, it became a Non electric,

tric, and conveyed the Electricity to the Ball as strongly as the Packthread had done.

EXPERIMENT II.

The Tube being well dried, I applied a Silk in the same manner as I had done the Packthread; but no Electricity could be conveyed to the Ball by applying the rubbed Tube to the contrary End of the Silk. But afterwards, having wetted the Silk, it became a Non-electric, and received the Electricity, which it communicated to the Ball.

N. B. I chose a glass Tube for this Experiment, because Mr. *Du Fay* had made use of glass Tubes for the Supporters of his Conductors of Electricity; and Silk, because Mr. *Gray* had supported his Conductors of Electricity upon Silk.

2. *An Account of some Experiments made before the ROYAL SOCIETY, on Thursday, May the 28th, 1741.*

THAT it is not the Quantity of Matter in Bodies, that makes them more or less receptive of Electricity, and conductive of it, but intirely their Quality, appears by the following Experiments.

EXPERIMENT I. Fig. 1.

From a Cat-gut String *AB*, about 12 Foot long, stretched horizontally Six Foot above the Floor of the Room, I suspended Two Iron Bars *CD*, *EF*, of about 40 Inches long, and a Quarter of an Inch square, by the silken Strings *Cc*, *Dd*, *Ee*, *Ff*, which at first touched at their Ends *D*, *E*; and from the End *F* of the Bar *EF*, there hung, by a Packthread, the ivory Ball *G*. Then having rubbed a large Tube *IK*

to excite its Electricity, I applied it near the End *C* of the First Bar; and the electrical Virtue ran along the Two Bars, and impregnated the Ball *G*, as appeared by its attracting the Thread hanging from the Stick *H*, at about Three Inches Distance. Afterwards I separated the Tubes, in the manner that they appear in the Figure; and the Electricity was communicated to the Ball but faintly when the Bars were an Inch and an half asunder, and not at all when they were Two Inches and an half asunder. But this was owing to the moist State of the Air; for, when the Air is very dry, the Virtue will jump Six or Nine Inches; but when the moist Particles, that float in the Air, are attracted by the Bars, the Virtue will reach but a little Way; though, if that Moisture be fixed upon any Body, which (being an Electric *per se*) would not conduct the Electricity applied to its End, the Virtue will be carried from one Bar to another as well as if they had touched, as will farther appear by the next Experiment.

EXPERIMENT II. Fig. 2.

Having separated the hanging Bars so far asunder, that the Electricity could not jump from the one to the other, (*viz.* about Three Foot) I laid upon their End the small Tube *DE*, having wiped it very dry: Then, applying the rubbed Tube to *C*, the Virtue stopped at *D*; and neither the Bar *EF*, nor the Ball *G*, received any Electricity, the Thread *H* being attracted by neither of them. But, having blown through the Tube, the Moisture of the Breath changes it from an Electric to a Non-electric; and then the Virtue of the rubbed Tube runs along freely from *C*

quite to the Ball at *G*, which then strongly attracts the suspended Thread.

N. B. When the Air is very moist, the Tube *DE* is turned to a Non-electric without blowing, only by the watery Particles adhering to it.

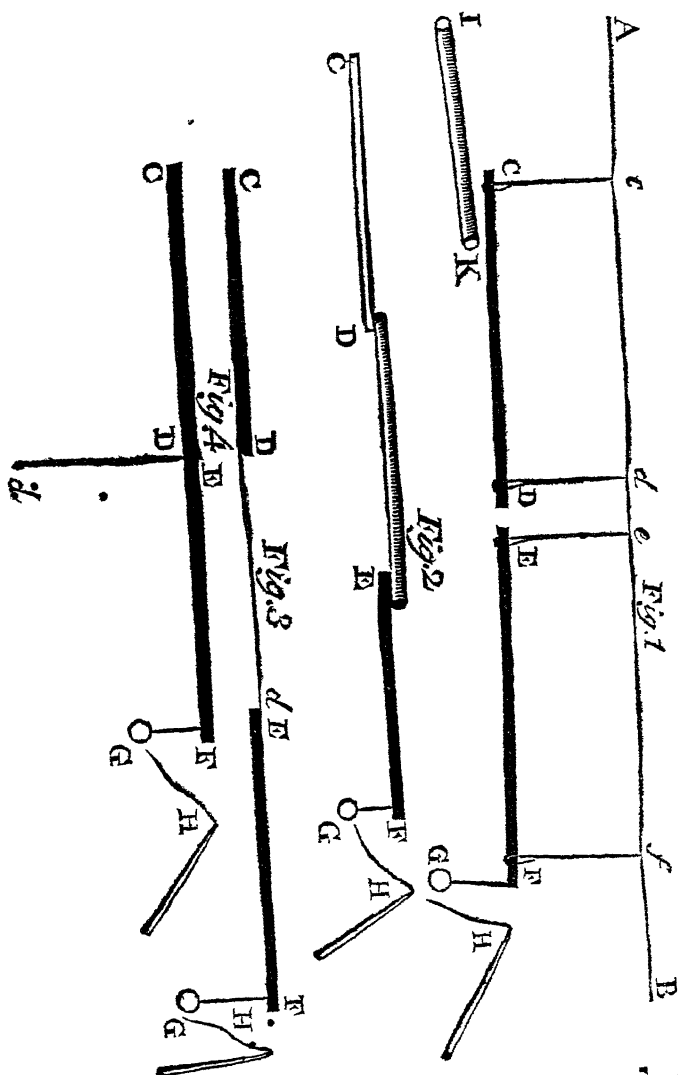
EXPERIMENT III. Fig. 3.

The Bars remaining in their Situation, I took off the Tube, and stretched a very fine white flaxen Thread from *D* to *E*, which touched both the Bars: Then applying the rubbed Tube to *C*, the Virtue was carried from Bar to Bar, and the Ball *G* attracted the Thread *H* at Two Inches Distance. Afterwards wetting the Thread, the Attraction became much stronger at *G*, so as to attract the Thread *H* at Four or Five Inches Distance.

EXPERIMENT IV. Fig. 4.

Having joined together the Ends of the suspended Bars, I suffered the Thread *Dd* to hang down, but touching no other Body; then the Electricity was freely communicated (by applying the rubbed Tube to *C*) from *C* to the Ball at *G*. But if *d*, the lower End of the Thread, touched the Ground, or a Chair, or was taken hold of by any body's Hand, or lifted up by a walking Cane; then the Electricity advanced no farther on the Bars than *D*, but was interrupted by the Thread *Dd*, and carried to the Bodies contiguous to *d*, when they are Non-electric. If the End *d* of the Thread was laid upon a dry glass Tube, held in the Hand of an Assistant, then the Electricity ran as before, along the Bars to the Ball *G*. The same thing also happened when the End *d* of the Thread was thrown up upon the Cat-gut String; for in that
Case

CASE the Electricity, having impregnated the String,
did afterwards run along the Bars, &c.



3. *An Account of some new Electrical Experiments, performed before the ROYAL SOCIETY, Thursday, Aug. 29. 1741.*

HAVING found by several of Mr. Gray's Experiments, as well as some of my own, that Water is receptive of Electricity, so as to be raised up in a little Cup, to emit a Vapour towards the rubbed Tube, to snap, and to give Light; having also found, (as I shewed the Experiment before the ROYAL SOCIETY) that when a dry Tube, suspended horizontally, will not conduct the Electricity of the rubbed Tube applied to one of its Ends; and yet, when blown into, will conduct it strongly all its Length, because the Electricity runs along from one moist Particle to another, though those Particles are not contiguous—I thought that Electricity might impregnate a whole Jet of Water, whether perpendicular, oblique, or horizontal: And supposed also, that if at any time there be electrical *Effluvia* in or above a Cloud, that Virtue may be communicated by the falling Rain, to any thing that the Rain falls upon. How far my Conjecture is true, will appear by the following Experiment.

Having properly suspended (that is, suspended by some electric Body, here Cat-gut) a copper Fountain with the Spout downwards, I opened the Cock, and let the Water spout into a Vessel underneath: Then, having excited a great Tube to Electricity, I held it over the copper Fountain, whilst an Assistant held the Thread of Trial (that is, a Thread hanging from a Stick) near several Parts of the Jet, which attracted it

it sensibly : Then I applied the rubbed Tube near to the falling Jet, which attracted it strongly, so as to bend it into a Curve, and sometimes cause it to fall out of the Vessel below.

II. *A Letter from John Huxham, M. D.
F. R. S. to Thomas Stack, M. D. F. R. S.
concerning an Extraordinary Venereal Case.*

Dear S I R,

I Have now sent you the uncommon Venereal Case I promised in my last, which, I think, hath something very remarkable in it, and seems very much to confirm the Great *Boerhaave's* Opinion, that the Seat of the *Lues Venerea* is in the *Membrana adiposa*.

Mr. *R. B.* aged about 27, of a bilious, dry Constitution, had, for some Years before his Death, contracted a virulent *Gonorrhæa*, which was scarce well cured before he got a Second, and at length a Third.—To complete his Misery, being in the Fleet at *Portobello*, he had frequent impure Conversation with some of the *Negro* Husbands (who probably laboured under the worst Species of *Pox*, called the *Taws*).

He returned with a very troublesome Itching all over him, though no Pustules appeared; was much thinner than usual, and had a horrible stinking Breath, and spit frequently a foul, corrupt Matter.—As he had no Running, Ulcer, *Bubo*, or *Nodes*, he thought all safe.—But not many Days after his Arrival at *Portsmouth*, *post impurum cum impurâ Coitum*, a violent Green-coloured *Gonorrhæa* appears.—For
this

this he put himself under the Care of a Surgeon, who, after much Pain to no Purpose, endeavoured to salivate him, but that also in vain.—The *Gonorrhœa* indeed was much abated, but a *Bubo* was risen in his Left Groin, and some small verrucose Eruptions about the *Anus*.

In this Condition he returned here, and put himself under the Hands of Mr. *St—*, an ingenious Surgeon, who endeavoured to bring the *Bubo* to Suppuration, but without Effect; for it soon receded, and forthwith violent Pains seized him in and about the Fundament, which soon produced an exceeding painful *Phyma* near the Verge of the *Anus* on the Left Side.

I was consulted now, and advised to bring it to Suppuration as soon as possible, which was done in Two Days; from whence issued abundance of purulent bloody Matter.—In a Day or two more, another appeared on the other Side, which soon vented the like Matter.—The *Verrucæ* also now grew more numerous and larger, and many pustular and scaly Eruptions appeared all over him.

I ordered him to be fumigated with *Cinnabar*, and advised him to enter on a Salivation forthwith.—But, antecedent to it, as his Humours were exceedingly tough and acrid, I put him on a Course of very plentiful Dilution; and this the rather, as he was naturally of a dry and hot Constitution, and besides had lately been roasted in the *Torrid Zone*.

I began, as usual, by giving him *Calomel*; which, though it neither purged or vomited him, yet, after having taken Five Drachms, produced no Degree of Salivation, nor did it make his Gums sore.—However, it brought on his *Gonorrhœa* again: I then

ordered him once and again, Eight or Ten Grains of *Turbith mineral*, which scarce puked him, and gave him only Two or Three Stools.—I now found, indeed, that *Mercury* and he, as well as *Venus*, had been old Acquaintance; so I greatly augmented the Dose of the *Mercurials*, ordering immense Quantities of thin watery Diluents: Notwithstanding this, there was very little Operation by Stool, and scarce any by Salivation. Though his Gums and *Fauces* were very sore and swoln, he scarce spit One Pint in 24 Hours, and that excessively tough and fetid.—Even under this strong *Mercurial* Course, the pustular and leprous Eruptions increased daily, so as to cover almost his whole Body, nay his very Face. His Hands and Feet were vastly swoln, as in an *Elephantiasis*, with horrid Fissures, from whence issued a very stinking ichorose Matter.

I was quite confounded at this dreadful Face of Things, and seriously bethought me what further Method could be taken against so terrible an Enemy.—I had recourse to a warm emollient Bath, in which his whole Body was immersed; after which he was well anointed with a strong *Mercurial* Ointment.—This was done for Three Days successively: Notwithstanding which, though his Chaps grew exceeding sore, and his Throat so much inflamed and pained, that he swallowed with extreme Difficulty what he sucked through a Pipe or Quill, yet the Spitting was very little increased, and as tough as ever: Nor did the fistulous Ulcers seem in the least disposed to heal up, but vented a vast Deal of stinking, oily, sanious Matter; nay, even new ones broke out under each *Axilla*, and a very large *Phyma* rose on the *Coccyx*,
S f f f
which

which soon discharged the ſame kind of virulent Matter; though we found the Bone, and even the *Perioſteum*, quite ſound and untouched.

The Scales were now grown ſo hard and ſtiff, that he could ſcarce bend a Limb, or Finger: Moreover, Abundance of Ulcers, from whence flowed great Quantities of greaſy, purulent, and ſomewhat bloody Matter, were broke out in his Thighs and Buttocks. —A very large Tumour was alſo riſen in his Right Breſt, and ſoon after on the Left, voiding prodigious Quantities of the ſame kind of Matter.

It was obſervable, that where-ever any of theſe Ulcers appeared, they ran only under the Skin, being intirely ſeated in, and feeding on, the *Membrana adipoſa*; ſo that the Muſcles and Tendons underneath appeared as fair and florid as in the moſt healthy Conſtitution.

I now unfortunately found, though too late, there was nothing to be done by *Mercury* in any Form; and therefore determined to run it off, and try the *Guaia-cum* Method and Sweating, ſo much recommended of old (and in ſome Caſes ſo juſtly) by Sir *Ulric Hutton*, and others; at the ſame time keeping up a moſt plentiful Dilution, attempting withal to detach the ſcaly *Cuticula* by continued emollient Baths, which at the ſame time alſo would partly act by Dilution.—By this means the Scales came off apace, juſt in the manner uſual in the confluent *Small-pox*; only the *Exuviae* were here much larger, ſeveral being above Four or Five Inches over.—In about a Week's time, this Coat of Mail was pretty well cleared off, and his Breath, from the moſt horribly nauſeous I ever ſmelt, became as ſweet as that of an Infant.

Infant. Nor was the Matter spit, though still very viscid, any way fetid: For the *Mercury* was pretty well run down by lenient Cathartics, and the Sloughs of his Mouth cast off.

He was now become exceedingly emaciated: Wherefore I ordered him plentiful liquid Nourishment with Vipers, and large Dilution, avoiding every thing that was in the least gross or fatty.—But with all this he still kept to his Three Pints of strong Decoction of *Guaiacum* every 24 Hours, sweating at least Two or Three of them.

Under this Method I conceived some Hopes of his Recovery, as he seemed now to gain some small Degree of Strength and Spirit; but still his Ulcers rather increased than abated, and continually discharged a vast Quantity of Matter, though by no means so thick, putrid, or bloody;—and, indeed, in a most profuse Manner from under each *Axilla*.

But, what is vastly surprising, notwithstanding all the past Method and Medicines, Two very large Chancres now appeared on the *Glans Penis*, and a very considerable *Bubo* in the Left Groin.—A troublesome Cough soon also seized him, with Shortness of Breath; and he began to expectorate a purulent, and sometimes bloody kind of Matter.—As the whole *Membrana adiposa* without, had been consumed by the Disease, it was now falling on that Part of it that invested the more vital Parts.—But Nature could support no longer.—He died in the extremest Degree of a pocky Consumption.—But not one single Bone of any Part of his Body appeared

to be touched, though he died with near 40 Ulcers upon him.

Dear SIR,

Plymouth,
Oct. 16 1739.

Your humble Servant,

John Huxham.

In another Letter dated at *Plymouth*, Nov. 30. 1739. Dr. *Huxham* says, " We have had a very tempestuous Season for several Days past, though now fair; the *Mercury* lower [28.1 Inches] than I have known it for some Years, and the Tides excessively high."

III. *An Account of Coal-balls made at Liege, by William Hanbury, Esq; F. R. S.*

IN pursuance of the Orders of the SOCIETY, I shall endeavour to give an Account of the factitious Coal made at *Liege*. But first I shall quote Two Authors, who mention it in their Accounts of the Town of *Liege*.

The First is, *Le Curieux Antiquaire, ou Recueil géographique & historique, par le Sr P. L. Berkenmeyer à Leide 1729. p. 182.* Where he says, " This Bishoprick (*Liege*) has rich Mines of *Houille* or " *Stone-coal* *, which the Inhabitants sell in the Ne-

* The common People call their Pit-coal, *del Hoy* or *de la Houille*; and the Mixture of Coal and Clay *de Houcky*.

“ *therlands*, and by the Sale of it they get above
 “ 100,000 Ducats *per Annum*.”

“ This Coal lights easily, and gives a great Heat :
 “ It is not therefore to be wondered, that Fire is
 “ reckoned amongst other Advantages the *Liegeois*
 “ boast of: They say, they have the best Bread, the
 “ hardest Iron, and the hottest Fire: By this last they
 “ mean, *de la houille*, which, being once well
 “ lighted, casts the greater Heat, if it be wetted with
 “ Water.”

The Second Book I shall mention is, *Les Delices des Pais Bas*, Vol. III. p. 243. where I find that this Town *Liege* is said to be “ the Hell of Women,
 “ because they are obliged to work more here than
 “ in any other Country. They draw the Boats, and
 “ carry on their Backs, like Slaves, *les boilles*, and
 “ other Things; and these Women are called *des Botresses*.”

In the Year 1628. by a printed Paper produced before you, it appears, that this Fuel was known in *England* at that Time; and if you will believe the Author of that Paper, it was discovered by *Hugh Plat* in 1594.

There is an Account of it printed in the Essays for the Month of *December* 1716. where it is proposed to be made with the black Ouse of the *Thames*, and for Four Pence per Bushel.

I have used this Coal and Clay mixed upwards of Ten Years, and by Experience I find it to answer very well. It is a most excellent Fire for Roasting, for heating of Irons, or warming a Room: I use it in my Kitchen, Laundry, Parlour, and Library.

The Method in which it is made at *Liege*, where I first saw it, and made some myself, is as follows:

Take $\frac{1}{3}$ of unctuous Clay, (such as Brewers use to bong their Vessels, in it there must be neither Sand, Gravel, or Stone)

And $\frac{2}{3}$ of Coal-dust: Mix, and make them incorporate well together; cast them into round Balls, or Bricks; and you may put them on a Coal-fire, and they will burn directly. But if they are made in Summer-time, and laid to dry for Use in Winter, they will light sooner.

Thus you have an hot, clean, lasting Fire, not at all offensive to the Smell.

The Dust is there the Refuse of the Mine, and may be here of the Coal-merchant's Yard, so that this Fuel comes exceeding cheap.

Nor is it necessary to put so much Coal-dust; for some Clay (particularly what I use myself in the Country) will do, if mixed $\frac{2}{3}$ Clay, $\frac{1}{3}$ Coal-dust; and the true Proportion of the Mixture must be found by Experience; but it is always better to put in too much than too little Coal-dust at first, because Men are too apt to be discouraged in making Experiments.

This Fuel is not only to be had at an easier Price, but it is likewise more durable.

How far it may be useful in Glass-houses, Brew-houses, Salt-works, &c. I must leave to the Consideration of the several Persons concerned in them.

I have heard, that at *Liege* they burn both Lime and Brick with it; but, as I never saw it done, I cannot affirm it.



IV. *A Letter from Cromwell Mortimer, M.D. Fellow of the Royal College of Physicians London, Secretary to the ROYAL SOCIETY of London, Member of the Gentlemens Society at Spalding, &c. to William Bogdani, Esq; F.R.S. and Member of the said Society at Spalding, &c. containing a short Account of Dr. Alexander Stuart's Paper concerning the Muscular Structure of the HEART: Which was read at several Meetings of the ROYAL SOCIETY in May and June 1735. drawn up at the Request of several Gentlemen of the Spalding Society. Now published with some Additions.*

Dear SIR,

I Was out of Town when your Letter of the 23d past came to my House, whereby you inform me, it would be highly agreeable to our Fraternity at *Spalding*, if I would oblige them with a short Account of Dr. *Stuart's* most curious Papers on the Heart, lately laid before the ROYAL SOCIETY: I did not come to Town till some Days after, and then I waited for an Opportunity of seeing Dr. *Stuart*, and asking his Leave to send you an Account of the Papers, as desired, which I ought not to do without it: These are the Reasons of my not having wrote sooner. I desire you to make my Compliments to
the

the Society, and beg their Acceptance of this rough Sketch of the Doctor's most curious Discoveries, which I have drawn by Memory, not having any of the Doctor's Papers by me, except some Drawings, of which I herewith send you Copies, [and are engraved, with some Improvements, in the Tables annexed; see TAB. I. Fig. 1, 2, 3, 4.]

I shall not here undertake to give a Description of all the Parts belonging to the Heart, supposing them already sufficiently known from the anatomical Writers; but shall only explain the surprising Simplicity of the *Muscular Structure* of the HEART, as the ingenious Dr. *Stuart* hath demonstrated it from various Preparations of boiled Hearts; viz. that *the Heart is nothing else than a single Muscle of nearly a semicircular Form, whose Fibres are all parallel:* For, suppose a rectangular Parallelogram *ABCD*, (see TAB. I. Fig. 1.) consisting of Two Squares *ABEF*, and *EFCD*; in each of which draw first the Diagonals *EB* and *CF*; then fill the whole Parallelogram, or both Squares, with Lines at equal Distances, and parallel to the Diagonals: This done, at the Centre *F*, with the *Radius FB*, draw the Semicircle *BED*. [and do the same on the Back-side of the Paper; so that every Line on the Back-side may lie exactly under each corresponding Line on the Fore-side, and that each Side may be as exactly alike, as if the Paper were transparent, and that the Lines might be seen equally plain on either Side:] Cut this Semicircle out of the Parallelogram, and cut out likewise a small semicircular Piece at the Centre *F*; then roll up this semicircular Piece of Paper in a conical manner, so that the Back-side of *D* [or to *I*, in Fig. 2.] be folded

to the Back of *E* [or to *H* in Fig. 2.] and this Fold turned round, till *E* comes to the Back-side of *B*. as in Fig. 3. and the Seam formed by the Edges *BF* and *EF* may be pasted together, only the inner Fold on the Right Side must be pushed back from the outer circular one, so as to form a Partition, as at *G*. in Fig. 4. and 3. by which means Two Cavities will be formed, that on the Right Side the Partition in this Form , the other, on the Left Side, almost circular, thus, , as in Fig. 4. the Outside of the first consisting but of one single Fold, the Outside of the latter consisting of a double Fold, and the Partition being but of one Fold: Thus the first Cavity represents the Right Ventricle of the Heart, the other the Left Ventricle, and the Partition *G* the *Septum*, as in Fig. 4. [All these Particulars are distinctly expressed in Fig. 2. which is to be cut off from Fig. 1. 3. and 4. and is to be folded upon the Line *BD*, so that the Letters *EE* and *HH* come exactly Back to Back, and that the Line *EF* and *HF* tally precisely; paste this Paper thus folded together Back to Back, then cut off the white Paper to the Rim of the Circle, and cut out a Piece at the Centre to *F*, and you will by this means have a semicircular Piece of Paper, with all the Lines represented on both Sides tallying to each other, as above described at Fig. 1. But as it was very difficult to print on each Side of the same Paper, so as to make the Lines tally, I thought it better to have this Figure printed in a whole Circle, that so such, as would be at the Pains, might cut it off, paste it, and fold it, and thus, as it were, form a Model of an Heart. In this Figure likewise I ordered the Engraver to distinguish the several Surfaces of the muscular Coats, by Lines and Dots, in such man-

ner as Colours are represented in Heraldry-graving : Thus the Outside of the Right Ventricle is shaded with Lines running from Top to Bottom pretty close, which denote that you should paint that of a dark Red; the Outside of the Left Ventricle, with Lines in the same Direction, but farther asunder, to denote a lighter Red; the Inside of the Right Ventricle is shaded with Lines from Right to Left, to denote it should be coloured (for Distinction-sake) blue; then, where the double Course of Fibres form the outward Side, or Left Side of the Left Ventricle, and which are not to be separated but by Art, there the Paper is left white or blank; but the Inside of the Cavity of the Left Ventricle is dotted, to represent yellow, that it may be coloured so: The colouring the Figure in this manner, makes all the Parts much more distinct, when rolled up into a Cone.]

This Model, if I may so call it, compar'd with the Heart of Man or Quadruped, will be found to answer in the following Manner: The Edge *BF*, in Fig. 1. or *EF*, in Fig. 2. answers to the tendinous Seam or *Sulcus*, which runs along the superiour Side of the Heart; and the Direction of the parallel Lines in Fig. 1. and 2. answers to the Course of the Fibres in each Part of the Heart; the circular Edge of the Paper *BED* answering to the tendinous Circle round the Base of the Heart, from which, and the Seam *BF*, all the muscular Fibres take their Original: The exterior Fibres of the Right Ventricle, next the *Apex* or Point of the Heart at *F*, decussate * each

* This may be imitated by gumming on Threads, in the same Directions as the parallel Lines in Fig. 1. turning them back cross the Hole left at *F*.

other, run inwards, and then, rising up again towards the Base, form that Side of the *Septum* which constitutes Part of the Inside of the Right Ventricle; and likewise form the *Columnæ carneæ* of the Right Ventricle: The Fibres of the interiour Course of the Left Ventricle decussate and form in the same manner the internal Fibres and *Columnæ carneæ* of the same Ventricle: The external Course of Fibres of the Left Ventricle are only a Continuation of those of the Right Ventricle, which together embrace the Heart circularly, while the internal Course of Fibres of the Left Ventricle run chiefly from the *Apex* towards the Base, so that on the Left Side of the Ventricle they cross the external Course nearly at Right Angles; but on the Side of that Ventricle which forms the *Septum*, they run from the *Apex* towards the Base, in the same Direction as on that Side of the *Septum* which is next to the Right Ventricle.

The several Courses of the Fibres may be easily traced in a boiled Heart; and if they are not found to answer to the Directions of the Lines on the Paper-cone with the strictest mathematical Exactness, when rolled up as at Fig. 3. you must consider, that the Form of the Heart is not exactly conic, though nearest reducible to that Figure; and moreover that the Base is not a Plane as in the Paper-cone, but of a convex round Form; and the tendinous Circle round it is of a smaller Diameter than the Middle Part of the Heart.

By this Structure and Circumvolution of the Fibres, the Muscle which constitutes the Heart, doth, by a simple Contraction of its Length, by those external Fibres, which encompass both Ventricles, contract the Diameter of the Heart, while by the internal

Fibres, that form the *Septum* and Inside of the Left Ventricle, it shortens the Length of the Heart, or draws the *Apex* up nearer to the Base: This is done without any Contrariety in the Action of these Fibres, or destroying the Force of each other; but, on the contrary, they being all parallel to each other, and a Continuation of the same Fibres, do assist each other in their Action.

The Doctor supposes this Contraction is not caused so much by the Influx of the nervous Spirits, as by the Influx of the arterial Blood, through the Coronary Arteries into the Substance of the Heart; and that the Contraction of the Auricles comes from the same Cause; which will be alternate with that of the Heart, because the lateral Branches, which arise out of the Trunk of the Coronary Artery, that encompasses the Base of the Heart and both Auricles, are on one Side distributed into the Substance of the Heart, and on the other Side into the Coat of the Auricles; and will be alternately compressed, and alternately free, as the Auricles and Ventricles are alternately full or empty of Blood.

I hope you will excuse the Imperfections of this short Account; and that our Brethren will accept it as a Mark of my Respect, and that it may satisfy their Curiosity for the present, till the Doctor's Account at large shall be published. I am,

London, Aug. 7.

S I R,

1735.
To W^m. Bogdani, Esq;
&c. [then] at Spal-
ing.

Your most obliged,
Humble Servant,

C. Mortimer.

V. *A Letter from M. le Cat, M. D. F. R. S. Surgeon to the Hotel Dieu at Rouen, and Royal Demonstrator in Anatomy and Surgery, to C. Mortimer, M. D. Secr. R. S. concerning the Foramen ovale being found open in the Hearts of Adults, and of the Figure of the Canal of the Urethra. Translated from the French by T. S. M. D. F. R. S.*

S I R,

I Have seen in the *Philosophical Transactions* of the ROYAL SOCIETY, N^o 439. that you are not displeased with Observations on the *Foramen ovale* in Adults. The *Anatomical Amphitheatre*, which I have established at *Rouen*, furnishes me with frequent Opportunities of observing. Last Winter, I applied particularly to the Circulation of the Blood in the *Fœtus*.—The Advantages that may be drawn from the Parallel, put me upon making the like Experiments on Adults. I have a number of times measured the Cavities of the Heart, and Vessels that depart from it, in both these Subjects; and I therein examined the State of the *Foramen ovale*, *Canalis arteriosus*, &c. I now send you my Remarks on the *Foramen ovale* open in the Adult, and some few others on the Figure of the *Urethra*.

I have the Honour to be, S I R,

Your most humble

and most obedient Servant,

Claud. Nic. Le Cat.

L. O.

1. *Of the Foramen ovale open in the Adult, and of its different Sorts.*

THIS last Winter I opened a great Number of dead Bodies of Men grown, and did not find the *Foramen ovale* open in any of them.

The oldest of the Male Subjects, in which I found it open, was a Lad of 15 Years of Age.

Of 20 Bodies of Women, which I examined, in Seven I found the *Foramen ovale* open.

Among the Number of Openings that remain of this *Foramen*, there is a great Variety in their Shape, and in that of the *Cicatrices* or Adherences of the *Valve*: However, they may conveniently be reduced to Three Sorts, expressed in the Figures hereto annexed, see TAB. II.

The First and Second Figure represent the First Sort of *Foramen ovale*, that remains open in the Adult.

The Third and Fourth Figures represent the Second Sort; and Fig. 5 and 6. the Third.

EXPLANATION of the FIGURES.

FIG. 1. The *Foramen ovale* viewed on the Side of the Right *Auricle*.

A. *A Valve that throws itself on the Side of the Left Auricle, and appears closed up chiefly by a Continuation of the Membrane that lines this Auricle.*

B. *The Place where this Valve leaves a Hole, which opens into the Left Auricle.*

C. *The*

C. *The Part contiguous to the Right Ventricle.*

Fig. 2. The same *Foramen ovale* viewed on the Side of the Left *Auricle*.

A. *The Valve drawn a little back, that the Hole may be seen.*

B. *The Point to which the Valve ascended, when left at Liberty.*

C. *The Part which leads to the Left Ventricle.*

Fig. 3. The Second Sort of *Foramen ovale* open in the Adult, and seen on the Side of the Right *Auricle*.

It differs from the First Sort, in being more sunk in, or more approaching the Shape of a Funnel.

Fig. 4. The same *Foramen ovale* of the Second Sort, seen on the Side of the Left *Auricle*.

It differs from the same Side of that of the First Sort, by the Valve beginning to make the Goose-foot by its different Attaches, which much resemble the Columns of the mitral Valves of the Heart. In the Figure I have added a Probe passed into the Foramen ovale from the Right Auricle to the Left.

Fig. 5. The *Foramen ovale* of the Third Sort open in the Adult, viewed on the Side of the Right *Auricle*.

This Sort differs from the preceding Two, by the Foramen ovale, nearly forming a Funnel.

Fig. 6. The same *Foramen ovale* viewed on the Side of the Left *Auricle*, and Two Probes passed into its Aperture.

This Sort differs from the preceding ones, by the Goose-foot formed by the Valve being much more compounded.

The Circle of Points A. marks the Place which answers the oval Cavity that is in the Right Auricle, and is the Cicatrix of the Foramen ovale at the Birth.

The Women in whom I have found the Foramen ovale of the Second and Third Sort, were about 60 Years of Age.

2. *The Figure of the Canal of the Urethra determined by solid Injections.*

THE Necessity I am under of founding frequently, and the Difficulties that I have sometimes met with in this nice Operation, have made me resolve scrupulously to examine the Figure of the Canal of the *Urethra*.

I have made thereon a number of Experiments, Two of which I shall now describe.

I.

I melted Resin with Wax, and injected this Liquid through the *Urethra*. I filled the Bladder but half way with it, in order to preserve all the Wrinkles of the Canal. When the Injection was cold and solid, I cut through the *Offa innominata*. I dissected the Left Side of the Canal and Bladder, and the Section of these Parts gave me Fig. the 1st, TAB. III. of which this is the Explanation.

Figure 1.

A. *The Glans.*

B. *An Elbow, which the Ligamentum suspensorium causes the Penis to make.*

C.

C. *Folds, or Wrinkles, of the Bulb or of the Gulf of the Urethra.* D. *The Entry or Streights of the Prostate.* E. *The Gulf of the Prostate, or the Verumontanum.* F. *Elbow, or Streights of the Entry into the Bladder.* G. *A Section of a Portion of the Bladder.* H. *A Section of the Pubis.* I. *The Root of the Left Corpus cavernosum cut through.*

II.

I injected another Subject with very thick Glue. I intirely filled the Bladder therewith through the Canal of the *Urethra*, until it was somewhat stretched. I let this Injection remain to the next Day, and then found it solid and elastic. I cut the Parts round it, as I had done in the preceding Subject; and afterwards I made an exact Division of the Injection: I put one half of it on Paper, in order to have its Shape exactly; and thereby I obtained the 2d Figure. To it I have added, in pricked Lines, a pretty exact Section of the adjacent Parts.

Figure 2.

A. *A Section of the Bladder.* B. *A Section of the Pubis.* C. *The Cavity of the Abdomen.* D. *The Peritonæum.* E. *The Integuments of the Abdomen.* F. *The Space between the Pubis and the Peritonæum, taken up by the cellular Membrane. It is the Place of the Incision in the high Operation of Lithotomy.* G. *The Rectum.* H. *The Glans.* I. *The Corpus cavernosum.* K. *The Urethra.* L. *The Elbow of the Ligamentum suspensorium.* M. *The Bulb or Gulf of the Urethra.* N. *The Streights and Elbow at the Entry of the*
U u u u
Gulf

Gulf of the Prostate. O. *The Gulf of the Prostate.* P. P. P. *Sort of Elbows, or blind Cavities, found therein.* Q. *The Streights of the Entry into the Bladder.*

VI. *A Letter from George Lynn, Esq; to Ja. Jurin, M. D. F. R. S. containing some Remarks on the Weather, and accompanying Three Synoptical Tables of Meteorological Observations for 14 Years, viz. from 1726 to 1739. both inclusive.*

SIR,

HAVING, for these 14 Years last past, kept a constant Register or Diary of the Altitudes of the Barometer and Thermometer, the Quantity of Rain, Course of the Winds, &c. according to your Invitation (in the *Philosophical Transactions*;) the Five first Years of which have been by you communicated to the ROYAL SOCIETY, and taken notice of in the *Transactions*; I now, Sir, send you the remaining Nine Years at large, ending *December* 1739. in the same Method as formerly. But, believing it would be of good Use, both here and abroad, if the Mean Heights of the Barometer, Thermometer, and Quantity of Rain in every Month of the whole 14 Years, with the collateral Means, both of the Months and Years, were brought all into one View together, I have taken the Pains to range them accordingly in a Scheme, or Table, herewith sent, which does not

tab 2

take up much above the Space of half a Sheet of Paper, and may be within Compass for inserting in the *Transactions*, either in a Plate, or otherways, as shall be thought proper. The Meaning of the several Columns in that Scheme is, in a great measure, explained by the Titles of them; and by the lowest Line you will find, that the Mean Height of the

Inches.

Barometer for the whole 14 Years is 29.58; the Mean Quantity of Rain annually, 23 Inches; and the Mean Altitude of the Thermometer $\begin{smallmatrix} 156145 \\ 52 \end{smallmatrix}$ that is, at the coldest time of the Day 56, at the hottest 48, and their Mean 52. In the middle Column, *viz.* that of Rain, the *Commas*, *Semicolons*, and *Colons*, over the Figures, denote, by their manner of placing, from the Left to the Right, what Time in the Month the Rain fell, whether at the Beginning, Middle or latter End; the *Comma* [,] denotes a small Quantity, the *Semicolon* [;] a middling Quantity, and the *Colon* [:] a large Quantity; shewing the different Proportion that fell at those Parts of the Months. The Thermometer made use of all along, is that of Mr. *Hauksby*, and kept constantly in the same Place, as mentioned by Mr. *Geo. Hadley* in the *Transactions*, N^o 447. And the Altitudes of the Thermometer are taken but twice a Day, *viz.* at the coldest, which is at Sun-rise, or sometimes a little after; and at the hottest, *viz.* between Two and Four in the Afternoon: By which Method are gained the proportional Heats for every Month in the Year, and their Difference, as also between that of Day and Night, for 13 Years together; not reckoning in the Year 1726. which may be seen

by the Scheme to be in another Method, and not filled up.

Great Care has been taken, in casting up and dividing, to get the exact Mediums and Sums; and I was not a little surpris'd to find, in casting up the Column of the Mean Altitudes of the Thermometer collaterally, that as those for *July*, being the hottest Month, are $\left| \begin{smallmatrix} 41 \frac{13}{10} \\ 35 \frac{1}{2} \end{smallmatrix} \right|$ so the Altitudes of *June* and *August*, on each Side of it, come out exactly equal to one another, and also those of *May* and *September*; these last only differing in their Morning and Evening Heats or Altitudes, which does not alter their Medium of $44 \frac{1}{2}$. Many other Observations may be made, both from the Scheme and Diaries at large, which, no doubt, will be taken notice of: But, having had ill Health of late, I am not able now to collect them, nor to form a Summary of the Winds, which I designed to have added some way or other in the same Scheme. As for any Judgment about the Weather, &c. it will be much better had from those who have the Perusal and Comparison of the many Meteorological Accounts sent to the ROYAL SOCIETY: I shall therefore only give a few cursory Notes of my own, as I find them, and so conclude this Letter.

When there is an Haziness in the Air, so that the Sun's Light quails by Degrees, and his Limb is ill defined, it is a pretty certain Sign of Rain, especially if the *Mercury* falls. The like Haziness, at Night, is still more a Sign of it.

It is observable, that though the *Mercury*, in the Summer Months, does not so much vary in its Altitude as at other times of the Year, yet in that Season

son we have the most Rain: It should seem therefore, that the different Warmths (and consequently Rarefaction of Vapours) in the upper and lower Currents of the Air, and those Currents mixing, and sometimes wholly interchanging, are then the more immediate Causes of the Rains, if not also of Thunder and Lightning.

Black fleecy Clouds, formed upon a sudden Flurry of the Wind, are generally succeeded by a Shower: And,

The shifting of the Wind in a little time almost round the Compass, in hot Weather, is often succeeded by a Thunder-shower.

Several times, when the *Mercury* has been a good while high, and so continues, there has fallen mistling Rain; especially about the New and Full Moon, with an Easterly Breeze, which the Borderers on the Coast of *Lincolnshire* and *Norfolk* call *Tide-weather*, and may be occasioned by the Vapours arising from the Tides, which then cover a vast Wash of Sands in their Neighbourhood.

Those Vapours sometimes reach us here in *Northamptonshire*, but I believe seldom further West.

The Nights are for the most part calmer than the Days; and the Winds seldom settled in their Quarter, or at their Strength, till some Hours after Sunrise, and generally die away again before Sunset.

I shall add no more, but that I am,

Southwick,
April 21. 1740.

N. Lat. 52°—31'.

Yours and the SOCIETY'S

most Obedient,

Humble Servant,

George Lynn.

Syn-

Synoptical Tables of the Meteorological Observations made by George Lynn, Esq; at Southwick, near Oundle in Northamptonshire, for the Years from 1726 to 1739. inclusively.

The Barometer's Mean Altitude (above 29 Inches) in 100 Parts of an Inch, In the Years							
	1726	1727	1728	1729	1730	1731	1732
<i>January</i>		.36	.28	.70	.79	.61	.54
<i>February</i>		.51	.86	.66	.39	.57	.65
<i>March</i>		.66	.48	.54	.34	.92	.57
<i>April</i>	.75	.72	.48	.60	.66	.51	.52
<i>May</i>	.74	.49	.64	.57	.55	.72	.50
<i>June</i>	.63	.58	.68	.69	.60	.66	.71
<i>July</i>	.68	.65	.64	.64	.61	.72	.65
<i>August</i>	.45	.77	.64	.72	.70	.65	.70
<i>September</i>	.44	.50	.59	.42	.34	.70	.63
<i>October</i>	.77	.44	.38	.52	.49	.67	.68
<i>Novemb.</i>	.74	.84	.53	.32	.55	.54	.75
<i>Decemb.</i>	.50	.33	.51	.52	.83	.61	.47
The Mean Altitudes in the several Years.		.57	.56	.57 $\frac{1}{2}$.57	.66	.61

The Barometer's Mean Altitude (above 29 Inches) in 100 Parts of an Inch, In the Years								The Mean Altitudes collate- ally.
	1733	1734	1735	1736	1737	1738	1739	
<i>January</i>	.68	.80	.47	.26	.86	.70	.45	.58
<i>February</i>	.55	.60	.63	.22	.58	.61	.60	.55
<i>March</i>	.43	.52	.36	.44	.45	.46	.48	.51
<i>April</i>	.65	.69	.49	.70	.67	.53	.34	.52
<i>May</i>	.70	.54	.60	.58	.70	.52	.60	.60
<i>June</i>	.67	.65	.56	.76	.73	.50	.56	.64
<i>July</i>	.67	.63	.50	.67	.59	.72	.67	.65
<i>August</i>	.56	.57	.72	.63	.55	.60	.61	.63
<i>September</i>	.62	.56	.69	.71	.46	.65	.49	.56
<i>October</i>	.72	.47	.69	.33	.60	.52	.71	.57
<i>Novemb.</i>	.75	.74	.45	.64	.68	.67	.32	.61
<i>Decemb.</i>	.53	.22	.59	.53	.70	.58	.65	.54
The Mean Altitudes in the several Years.	.63	.58	.56	.54	.63	.59	.54	.58

The Quantity of Rain in Inches and Decimals for
every Month, In the Years

	1726	1727	1728	1729	1730	1731	1732
<i>January</i>	4.2	3.1	4.0	0.2	0.4	0.8	3.9
<i>February</i>	1.0	2.6	0.9	0.5	1.5	1.0	1.2
<i>March</i>	1.5	1.4	3.3	1.3	2.6	0.1 $\frac{1}{2}$	1.4
<i>April</i>	1.0	1.2	2.0	1.1	0.8	2.1	1.2
<i>May</i>	0.4	4.3	1.4	1.6	2.5	0.3	3.4
<i>June</i>	4.0	3.2	2.8	0.8	3.4	3.4	0.6
<i>July</i>	3.7	2.0	3.2	2.3	2.0	1.7	1.8
<i>August</i>	0.3	0.3	1.0	2.4	0.8 $\frac{1}{2}$	1.6	1.7
<i>September</i>	5.2	2.0	0.8 $\frac{1}{2}$	5.3	1.6	1.5	0.7
<i>October</i>	1.5	1.5	2.8	2.2	3.0	1.4	3.7
<i>Novemb.</i>	1.4	0.4	1.5	4.2	2.0	1.5	1.2
<i>Decemb.</i>	2.5	2.8	2.4	1.7	0.8	2.3	2.6
The Mean Quantity of Rain in the several Years.	26. $\frac{1}{2}$	25.	26.	23 $\frac{1}{2}$	21.	17. $\frac{1}{2}$	20. $\frac{1}{2}$

The Quantity of Rain in Inches and Decimals for every Month, In the Years

	1733	1734	1735	1736	1737	1738	1739	The Mean Quantity collate- rally.
<i>January</i>	1.0	0.5	2.1	2.3	1.0	1.7	2.4	1.8
<i>February</i>	1.4	2.6	0.7	2.9	2.2	0.8	3.1	1.6
<i>March</i>	2.2	1.8	2.2	2.1	2.1	1.0	1.3	1.7
<i>April</i>	1.0	0.6	1.7	0.6	0.4	1.3	2.2	1.2
<i>May</i>	0.02	5.1	1.5	0.8	1.7	1.9	1.9	1.9
<i>June</i>	2.0	1.3	2.4	1.4	1.8	3.4	1.5	2.3
<i>July</i>	2.2	1.8	2.3	6.0	0.7	1.2	1.7	2.3
<i>August</i>	3.6	4.0	3.2	1.7	5.7	1.6	2.5	2.2
<i>September</i>	1.4	1.7	3.2	1.4	3.8	1.8	1.8	2.3
<i>October</i>	0.6	2.8	1.7	2.6	1.8	1.8	0.8	2.0
<i>Novemb.</i>	0.5	0.9	1.7	0.6	0.6	0.7	1.7	1.4
<i>Decemb.</i>	1.7	4.4	2.1	2.0	2.3	1.2	1.9	2.2
The Mean Quantity of the Rain in the several Years.	$17\frac{1}{2}$	$27\frac{1}{2}$	25.	24.	24.	18.	$22\frac{1}{2}$	23.

The Thermometer's Mean Altitudes taken (from April 13th 1727.) at the College and House Time of the Day, and their Mean, In the Years

	1726	1727	1728	1729	1730
<i>January</i>		at 10 at 3 65	68 65 66 $\frac{1}{2}$	70 66 68	69 64 66 $\frac{1}{2}$
<i>February</i>		at 10 at 3 59 57 58	69 62 65 $\frac{1}{2}$	74 67 70 $\frac{1}{2}$	68 61 64 $\frac{1}{2}$
<i>March</i>		at 10 at 3 62 58 60	59 53 56	69 60 64 $\frac{1}{2}$	62 54 58
<i>April</i>	at 10 at 3 40 33 36 $\frac{1}{2}$	52 45 48 $\frac{1}{2}$	57 47 52	61 50 55 $\frac{1}{2}$	58 46 52
<i>May</i>	at 10 at 3 25 20 22 $\frac{1}{2}$	45 39 42	47 35 41	53 42 47 $\frac{1}{2}$	49 38 43 $\frac{1}{2}$
<i>June</i>	at 10 at 3 36 31 33 $\frac{1}{2}$	42 32 37	41 30 35 $\frac{1}{2}$	43 30 36 $\frac{1}{2}$	46 35 40 $\frac{1}{2}$
<i>July</i>	at 10 at 3 37 31 34	37 26 31 $\frac{1}{2}$	41 31 36	42 30 36	42 32 37
<i>August</i>	at 10 at 3 40 31 35 $\frac{1}{2}$	43 27 35	43 34 38 $\frac{1}{2}$	43 31 37	44 32 38
<i>September</i>	at 10 at 3 43 43	49 38 43 $\frac{1}{2}$	53 43 48	46 37 41 $\frac{1}{2}$	47 39 43
<i>October</i>	at 10 at 3 52	57 51 54	58 52 55	57 50 53 $\frac{1}{2}$	55 43 49
<i>Novemb.</i>	at 10 at 3 62	66 60 63	67 61 64	60 57 59 $\frac{1}{2}$	59 52 55 $\frac{1}{2}$
<i>December</i>	at 10 at 3 70	71 68 69 $\frac{1}{2}$	72 70 71	63 60 61 $\frac{1}{2}$	70 65 67 $\frac{1}{2}$
The Mean Altitudes of the Thermometer in the several Years	54 46 50	56 49 52 $\frac{1}{2}$	57 46 52 $\frac{1}{2}$	57 46 52 $\frac{1}{2}$	56 47 51 $\frac{1}{2}$

The Thermometer's Mean Altitude taken at the coldest
and hottest time of the Day only, and their Mean,
In the Years

	1731	1732	1733	1734	1735
<i>January</i>	75[69 72	70[65 67 $\frac{1}{2}$	65[58 61 $\frac{1}{2}$	71[65 68	68[42 65
<i>February</i>	70[63 66 $\frac{1}{2}$	61[53 57	64[56 60	61[54 57 $\frac{1}{2}$	66[59 62 $\frac{1}{2}$
<i>March</i>	63[52 57 $\frac{1}{2}$	64[53 58 $\frac{1}{2}$	64[55 59 $\frac{1}{2}$	59[49 54	64[56 60
<i>April</i>	62[52 57	56[48 52	57[46 51 $\frac{1}{2}$	56[44 50	55[46 50 $\frac{1}{2}$
<i>May</i>	50[34 42	53[44 48 $\frac{1}{2}$	54[40 47	51[42 47 $\frac{1}{2}$	53[43 48
<i>June</i>	45[31 38	46[34 40	45[29 36	44[34 39	46[37 41 $\frac{1}{2}$
<i>July</i>	43[29 36	42[31 36 $\frac{1}{2}$	38[27 32 $\frac{1}{2}$	40[31 35 $\frac{1}{2}$	42[23 37 $\frac{1}{2}$
<i>August</i>	42[32 37	47[33 40	45[34 39 $\frac{1}{2}$	42[32 37	43[33 38
<i>September</i>	46[36 42	49[39 44	52[44 48	51[43 47	46[38 42
<i>October</i>	52[46 49	55[47 51	60[52 56	60[53 56 $\frac{1}{2}$	60[52 56
<i>Novemb.</i>	62[57 59 $\frac{1}{2}$	67[62 64 $\frac{1}{2}$	61[55 58	66[62 64	59[54 56 $\frac{1}{2}$
<i>December</i>	66[61 63 $\frac{1}{2}$	66[64 66	58[53 55 $\frac{1}{2}$	67[63 65	64[60 62
The Mean Altitude of the Thermometer in several Years.	56[47	57[48 52	55[46 50	56[48 52	56[48 52

The Thermometer's Mean Altitude taken at the coldest and hottest time of the Day only, and their Mean,
In the Years

	1736	1737	1738	1739	The Mean Altitudes collaterally
<i>January</i>	64[50 62	63[59 61	63[57 60	63[58 60 $\frac{1}{2}$	67[62 64 $\frac{1}{2}$
<i>February</i>	71[67 69	65[59 62	66[61 63 $\frac{1}{2}$	60[53 56 $\frac{1}{2}$	66[59 62 $\frac{1}{2}$
<i>March</i>	63[54 58 $\frac{1}{2}$	65[58 61	62[54 58	65[57 61	63[55 59
<i>April</i>	57[46 51 $\frac{1}{2}$	56[47 51 $\frac{1}{2}$	58[49 53 $\frac{1}{2}$	60[52 56	57[48 52 $\frac{1}{2}$
<i>May</i>	54[44 49	49[35 42	48[36 42	48[37 43	50[39 44 $\frac{1}{2}$
<i>June</i>	42[30 36	47[35 41	46[37 41 $\frac{1}{2}$	44[33 31 $\frac{1}{2}$	44[33 38 $\frac{1}{2}$
<i>July</i>	41[31 36	41[29 35	42[30 36	42[32 37	41[30 35 $\frac{1}{2}$
<i>August</i>	42[32 37	41[39 43	45[37 41	41[36 41	44[33 38 $\frac{1}{2}$
<i>September</i>	49[38 43 $\frac{1}{2}$	47[40 43 $\frac{1}{2}$	51[43 47	48[41 44 $\frac{1}{2}$	49[40 44 $\frac{1}{2}$
<i>October</i>	53[47 50	60[55 57 $\frac{1}{2}$	57[50 53 $\frac{1}{2}$	60[53 56 $\frac{1}{2}$	57[50 53 $\frac{1}{2}$
<i>Novemb.</i>	62[57 59 $\frac{1}{2}$	62[56 59	63[57 60	68[63 65 $\frac{1}{2}$	63[58 60 $\frac{1}{2}$
<i>December</i>	63[60 61 $\frac{1}{2}$	67[65 66	65[62 63 $\frac{1}{2}$	70[66 68	66[63 64 $\frac{1}{2}$
The Mean Altitudes of the Thermometer in the several Years	55[47 51	56[48 52	55[48 51 $\frac{1}{2}$	56[48 52	56[48 52

VII. *Remark of the Case of a poor Woman who had a Fœtus in her Abdomen for Nine Years, opened May 6th 1739. by William Bromfeild, Surgeon.*

THIS poor Woman, about Nine Years since, was with Child, and, at the Expiration of the usual Time, was attempted to be delivered.—The Child was so far advanced in the Passage, that the Midwife declared, that in less than Two Minutes the Child would be in the World; but, on the Woman's suddenly turning herself, the Child slipped from the Midwife, and could not be found by her again.

Previous to her being pregnant, she had been afflicted with the Venereal Disease, and had had a violent Discharge of a fetid Matter from the *Uterus*, and was then under the Care of Mr. *Balgay*, Surgeon, who favoured me with being present when he opened the Body.—She had been salivated once or twice in our Hospitals, but to no Purpose.—After the Time of attempting to deliver her, to the Hour of her Death, she had prodigious Discharges of a fetid Gleet, and frequently indigested Matter with Blood from the *Uterus*.—There appeared a Tumour on the Right Side, which was moveable to the other, though its Attachment was chiefly to the Right.—She was troubled with a Suppression of Urine, ever since the Attempt of Delivery, and within this Twelvemonth went to Stool in a Cloth insensibly, and what *Fæces* descended into the *Rectum*, were immediately discharged.—She gradually wasted from a hale lusty Woman,

Woman, till she was reduced to a mere Skeleton.—
This Account is the best I could collect from the good Women who were present at the opening of the Body, and most of them at the Time of her expected Delivery, and have been very conversant with her ever since. —

Upon opening the Body —

The *Omentum* was intirely wasted: The *Peritoneum* was greatly inflamed, and adhered to the subjacent Tumour, which I expected (not being acquainted with the Case) to be a Tumour of the same kind I had lately seen, which was chalky; but, upon cutting into it, there appeared the *Os Frontis*, and, on proceeding farther, the Arm, Leg, and Ribs, on the Left Side,—with some viscid Matter in the Interstices. —It was seemingly contained in a thick membranous Cyst—which, upon Dissection, proved to be, the containing *Membranes* of the *Fætus*, contracted to the Shape of the *Fætus* in *Utero*, and gave the Tumour an oval Form.—The Situation of the *Fætus* was in the concave Part of the Right *Ilium*, and by its Cyst was attached to the *Intestines*, *Colon*, and *Cæcum*.—It had some Vessels that ran on the Surface of the Cyst, that was sent from the internal *Iliacs* of the contrary Side.—By its Pressure on the Right *Ureter*, it had hindered the Descent of the Urine, and had greatly enlarged both the *Ureter* and *Pelvis*, (of the Right Kidney) which was greatly distended with Urine, so that what descended into the Bladder, must steal in *guttatim*.

The *Uterus* and *Fallopian Tubes* appeared of their usual Size, only inflamed.—The *Fimbriae* were loose and fluctuating. On examining farther into the *Pelvis*,

Pelvis, there was near Six Ounces of fetid Matter lying between the *Rectum* and *Uterus*, which near its Neck was perforated, and the Parts were very rotten. From its Neck almost to the Extremity of the *Vagina*, the Muscles of the *Anus* were nearly destroyed. — There were some few indurated little Tumours adhering loosely to the Cyist of the *Fætus*. — There were several little Parts appeared like carious Bones found in the Matter contained in the *Pelvis*. —

From what has been said, it appears that the *Fætus* had been Nine Years in the *Abdomen*.

VIII. *A Letter from Mr. John Powell, to Sir Hans Sloane, Bart. Pr. R. S. &c. concerning a Gentlewoman who voided with her Urine, hairy crustaceous Substances: To which is annexed Sir Hans Sloane's Answer, containing several Observations of extraordinary Substances voided by the Urinary Passages.*

Honoured SIR, *Pembroke, July 16. 1733.*

HAVING the Opportunity of sending now to London by a safe Hand, I make bold to send you in a Box, some things that a worthy Divine's Daughter of this Neighbourhood, whose Father has been some Years dead, and her Husband now too, has voided ever since *Michaelmas* last was Two Years,

Years, unless it were about Nine or Ten Weeks last Summer. She is near 40 Years of Age, and has been married about 17 Years, and had a Child about 12 Years ago, that lived about Nine Weeks.

About *August* last was Two Years, she was seized with a Stoppage in her Urine, a small Pain in her Bladder, and a great Pain in the Bottom of her Feet, with the making of whitish Water like Whey; and she had then a great Weakness in her Limbs, and a Pain in her Bowels; for which another Gentleman, Six Miles off hence, ordered her to go into the cold Bath, by which she found great Benefit for the Pains in her Limbs; but the Pain in her making Water rather increased, and then her Urine began to grow fetid; and about *Christmas* was Two Years, she voided the largest of the Things you find in the Box, without any very great Pain then, being she had taken a quieting Draught that Night to compose her; but, almost ever since, they put her to most exquisite Pain before she can get them off; and she is commonly forced to take the small Part of the hairy Part between her Fingers, before she can get them off; and oftentimes a good deal of Blood comes off with her plucking them, which makes her very sore inwardly.

Upon using gentle Evacuations last Spring was Twelvemonth, she grew much better; such as Vomiting with the *Hypocacuanha*, Purging with *Manna*, Oil of Sweet Almonds, &c. and, taking sometimes Calomel the Nights before, and very often diuretic and balsamic Pills, with and without *Trochisc. Gordon.* and emollient Decoctions and Emulsions of several Kinds, the Feter and Roapiness in her Urine abated, and she was pretty hearty and brisk, so that she

she undertook last *August* a Journey into *Herefordshire*, and staid there near Two Months, and, I fear, she might take some Cold in her Journey; for her Pains grew worse, and more troublesome, after her return home; and she then voided great Quantities of those large Substances, as well as small, that you see; and her Urine grew extraordinary ropy and fetid, notwithstanding all the Endeavours of another Gentleman and myself; and very often the Substance she voided would be so stiff and ropy, that we could scarce separate it from the Pot; at other times so pliant, that you might take it up a great Height with a Sprig of a Broom, or a Feather, and so fall down again like a Lump into the Pot.

She has for this considerable time voided one or more of these hairy crustaceous Substances every Day or Night; they looking, when they are first voided, like Hair and Coralline; and her Pains are so very exquisite, that we are forced, every Third Night at farthest, to give her an Anodyne to quiet her; and that often cannot be done, her Pain being so very great.

The Continuance of this severe Pain has brought her to a very considerable Weakness, and almost a total Loss of Flesh; and, what is her great Misfortune, (especially at this Season of the Year) that Milk will by no means agree with her: She has often tried to conquer it, but never could, it constantly making her very sick in her Stomach, and she vomiting it up in great large Lumps.

We have used Injections of Two or Three Sorts, but she cannot well bear them; and she has had her *Menses* very regularly, till within the Two or Three last Times;

Times; and for these 10 or 12 Days past, she has complained of a Swelling in her Belly, but none in her Thighs nor Legs.

One thing I had almost forgot to have told you, that she has often found a *Crepitus*, or a breaking of Wind, as it were, in her Bladder; which would make one believe, that there is an Aperture from the *Intestinum Rectum* to the Bladder.

Her Bladder has been searched, and the Surgeon who did it, assures her, he can discover no Stone; and he is a very ingenious Person in his Profession.

She has for these Four or Five last Days complained, at times, of asthmatic Fits, which I must attribute to the Heat of the Weather.

The Voiding of these hairy crustaceous Substances never occurred to me in my Practice before; though I have above once had Persons voided large Bladders, like the *Hydatids* in Fish, and large Quantities of them, and cured them.

These Substances therefore I beg Leave to send to you, being, I reckon, there is scarce any thing that escapes your Observation: But whether they have, or have not, I desire your Opinion of them; and beg you will be pleased to inform me what Course you judge most proper I should take with her.

S I R,

*Your most obliged, humble,
and obedient Servant,*

John Powell.

P. S.

She drank the Hot-well-waters both at *Bristol* and here, but with little Success; has taken *Cantharides* in-

inwardly, as prescribed by Dr. *Groenvelt*, in Ulcers of the Bladder, and all other things we could think of.

Sir Hans Sloane's Answer to Mr. Powell.

SIR,

London, July 26. 1733.

I Received yours of the 16th Two Days since, together with the Box, and Contents thereof; which I have considered, and am satisfied, that the hairy Excretions are generated most likely in her Kidneys. I have seen, in my Practice, some Instances of the like, and have by me what was brought off by Urine from some of them. The first I remember, was from a Gentleman near the *Exchange*, who would frequently, Forty Years since, void with his Urine long Hairs, which were received on white Paper; and, the Urine passing off, would remain there, and, by their Transparency and Angles, yielded, on viewing by a Microscope, the finest Colours imaginable, such as we find by a Prism. This Gentleman did not suffer much, though he complained of a Sharpness of Urine. The Person who was affected the most, and applied to me for Help, was a Brewer, who had such Hairs matted or woven together, voided by Urine with great Pain: But then there was no calculous Matter, or very little, added to them. It is very likely, that that Matter is added to those of your Patient in the Bladder, by being retained there. I have a Pin, that a young Woman had swallowed, and was afterwards taken

out of her Groin from an Apoffem after a Tumour ; which Pin was covered or incrufted, as thefe hairy Subftances, with fuch calculous Matter, and got there from the Urine in her Bladder, where in all likelihood it had contracted that Cruft. I have a filver Bodkin, the broad End of which is covered with a pretty large Stone. A poor Gentlewoman thought, by thrufting this Bodkin up the *Meatus urinaris*, to remove a Stone which preffed upon the Neck of her Bladder, and it flipt paff Recovery into her Bladder ; whence, after Three Years, it was taken, and on which, as on a Centre, was bred the Stone. I have other Inftances of the fame, where an extraneous Body, paffed into the Bladder, hath proved as a Centre to attraft or have affixed to it fuch Matter.

As to the Cure, Dilution feems to be the beft. The Brewer was cured by drinking plentifully of foft Liquors, which he often poured down ; and twice a Week he took the purging Waters. You may guefs my Opinion to be, that the lefs is generated of this Matter, and the lefs Time it remains in either Kidneys, *Ureters*, or Bladder, the Difcfe will be mitigated, and, I hope, cured. I believe *Bath-waters* drank warm, Mallow-tea, Linfeed-tea, Oil of fweet Almonds, Syrup of Marshmallows, little and often taken, with Baths of emollient Herbs, may be of great Ufe ; and perhaps moderate Exercife may help them off. Opiates, in exceffive Pain, are neceffary ; and now-and-then Bleeding, to take off the Inflammations that muft of neceffity attend fuch a Diftemper. I alfo think, that fome Balsamics, fuch as *Locatelli's Balsam*, may be ufeul ; and perhaps, with the emollient

lient Method, take off that Disposition in the Kidneys, which produces this uncommon Distemper. The Pains in her Feet, and about her, seem not to have any relation to this Distemper; and I am of Opinion, that violent Diuretics or Exercise will rather hurt than help her. Thus you have my Thoughts on this very extraordinary Case; and I shall be very glad to hear of the Issue of it, and rejoice if I can be useful to you in this or any thing else, leaving to you the Determination of what you think reasonable. I beg Pardon for this hasty casting together some things, which, if I had more Time, should be put into better Order by

*Your most obedient,
and most humble Servant,*

Hans Sloane.

IX. *A Letter from Mr. T. Knight to Sir Hans Sloane, Bart. Pr. R. S. &c. concerning Hair voided by Urine.*

Hon^{ble} SIR, Carnarvon, Feb. 20. 1737.

HAVING met with an uncommon Case, I thought it proper to communicate the same to you, in order to be informed whether the like ever occurred in your long and successful Practice, and also to beg your Sentiments upon the Matter.

The

The hairy Substance, or fine *Capillamenta*, inclosed in the Pill-box, were discharged along with the Urine of a Gentleman during a severe Fit of *Ardor Urinæ*; the Gravel that came away was inconsiderable, so that the Cause of the Dysury was chiefly owing to the hairy Substance with the gritty Matter that adheres to it, inflaming, by their Irritations, the *Ureters* and *Sphincter Vesicæ*, and Parts adjacent. For, notwithstanding *Phlebotomy*, lenient Clysters, Emulsions, Opiates, and such-like Remedies, were strictly used, all proved ineffectual, till all this extraneous Substance was come away.

These fine *Capillamenta* seem to be the Tegument of an Animal which had got into the *Primæ Viæ*, and passed the *Venæ Lactææ*, and, by Circulation, passed also the *Glandulæ Renales*. For it is more probable, (with Submission) that they were extraneous, than that they were generated in the Urinary Passages, in an equivocal Manner.

The greatest Objection, that offers to me, is, that it is judged absolutely necessary, that the *Venæ Lactææ* should be smaller than the finest Artery in the Body, that nothing might enter, which might stop Circulation of the Blood. Also,

That the Mouths of the *Lactæals*, which are open into the Cavity of the *Intestines*, (from whence they receive their Chyle) are so small as not to be seen by the best Microscope in dead Bodies.

To obviate these Objections, may not the Mouths of the *Lactæals* be perceptible in living Bodies, when dilated, distended, and turgid with Chyle? And may not these *Capillamenta*, when relaxed with any Humidity, become very flexible, pliable, and susceptible
of

of being contorted, and of assuming any Figure*; and, when thoroughly relaxed, disseminated and floating in a Fluid, enter the *Lacteals*; and consequently may pass through the Convolution of small Arteries, whereof the Glands and secretory Vessels are formed? for a Gland is said to be nothing else but a Convolution of small Arteries.

N. B. This Gentleman has kept a strict Regimen of Diet for many Years, as being subject to frequent Fits of the Gout, an Incontinency of Urine, &c. In the Morning early, a Draught of Cows Milk, *statim ab Utere*; which oft doth not pass a *Colatorium*, whereby some of the downy Hair about the Udder might get along with the Milk into the *Primæ Viæ*, &c. I am, with great Respect,

*Your most obliged,
and most obedient,
humble Servant,*

T. Knight.

* The *Capillamenta*, whilst in the Urinal, and till the Urine was decanted, appeared only like a gross turbid Liquor, the Filaments being so diffused.

Remark.

I doubt of these Substances being *real Hairs*; I imagine they are rather slender grumous Concretions, formed only in the Kidneys by being squeezed out of the excretory Ducts into the *Pelvis*. *C. M.*

X. *An Account of an extraordinary Case communicated by Dr. Walter Graham, Physician at Mansfield, to Dr. Mortimer, Sec. R. S. concerning a large Quantity of Matter or Water contained in Cyrtis's or Bags adhering to the Peritonæum, and not communicating with the Cavity of the Abdomen.*

IN the Middle of *February* 1735. *Jane Dawson*, of the Parish of *Mansfield* in *Nottinghamshire*, an unmarried Woman, aged Thirty, received a violent Strain by lifting a Tub of Water, and immediately complained of great Pain in her Left Side.—In *March* following, she found a Lump, or little round Swelling, in that Side of her Belly; and soon after the whole *Abdomen* swelled, but more in the Left than in the Right Side.—She complained frequently of severe Pains in her Bowels, which, in Time, became so violent, that she had neither Ease or Sleep, but by taking large Quantities of Opium.—During her Illness she made very little Urine, and was so costive, that she had seldom any Stools but by the Help of Purges or Clysters: The former gave her always Pain, and the greatest Relief she found, was from emollient Clysters that emptied the *Intestines*.—Her Thighs and Legs were not swelled, but these and other Parts of the Body were much emaciated.—In this unhappy Condition the poor Woman lived about Two Years Nine Months, and died on the 17th of *November* 1738.

I should have mentioned, that, before this Accident of the Strain, she had always enjoyed a tolerable good Share of Health; and seldom made any Complaint, but of missing her *Menstrua*.

Upon viewing the naked Body, the *Abdomen* was vastly distended, and most at the Navel: The Swelling was unequal, the Left Side being more swelled than the Right; and there appeared a very distinct Protuberance all along the Left *Epigastrium*: This Protuberance was much softer than the other Parts of the Belly, which were so hard, that upon Pressure they did not pit.

Upon opening the Body, we observed as follows:

The *Membrana adiposa* was very thin, and the *Abdominal Muscles* were much extenuated by the great Distention, as is usual in like Cases.

The *Peritonæum*, which was the chief Seat of the Distemper, and the principal Part to be taken notice of, was grown to so monstrous a Thickness, that its Section at the Navel was Five Inches and Two-tenths of an Inch; and it was of the same Thickness below, but somewhat thinner above it.—All over the *Peritonæum*, and throughout the Whole, there appeared a prodigious Number of Glands; and the Space betwixt one Gland and another was filled with a white spongy Flesh.—Some of these Glands were round, others oblong: Many of them were as large as a Goose's Egg, others about the Bigness of a Pigeon's Egg, and some less; the largest were on the Left Side.—Their internal Substance was destroyed, and only the external *Membranes* left, whose Cavities were full of Liquors of different Colours and Consistence: Some contained a thin whitish Humour, others a pellucid

viscous Gelly, like the White of an Egg, and some a white thick Matter, like *Pus*.—As the Contents of these *Glands* thus differed, so did their *Membranes*; some were very thin, others thicker, and many of them were become *cartilaginous*: In general, those whose *Membranes* were thin, contained a thin whitish Liquor; and those that were *cartilaginous*, a thick white Matter like *Pus*.—Their internal Surface was quite smooth, and none of their Cavities had any Communication with each other; nor could the Matter be pressed out, without opening them with a Knife.

The Protuberance on the Left *Epigastrium* was occasioned by a Quantity of Liquor lodged in a Cavity formed by the *Peritoneum*, which in this Place was about Two-tenths of an Inch thick: This Cavity extended itself over the Kidney and Spleen, and there was found in it above Two Quarts of thin Liquor of a darkish Colour.—The whole Quantity of Matter taken out of the fore-mentioned Cavity, and those of the *Glands* which were opened, was about Four Gallons.

In the Cavity of the *Abdomen* there was found no Matter, or Water.

The *Omentum* was very white, and much decayed.

The Coats of the Stomach and *Intestines* were very thin and tender, and inflamed in several Places.—The *Intestines* lay in the Right Side, and were filled with hard Excrements, forced into that Situation by the large Protuberance on the Left.

The Liver was very large, of a Colour more red than common, and full of Blood, which upon the smallest Incision flowed freely out of it; and the
greatest

greatest Part of the Blood in the whole Body seemed to be accumulated in this *Viscus*, and was of a darker red Colour than usual.

The Gall-bladder was not bigger than natural, nor did it contain any Stones, or concreted Matter; and, upon gentle Pressure, the Bile moved easily through the *Ductus Cysticus*.

The *Pancreas* was smaller than common, and adhered closely to the *Duodenum*.

The Kidneys were a little inflamed, and of a flatter Figure than usual; occasioned, as I suppose, by the Pressure of the *Peritonæum*.

The Cavity of the *Thorax* was greatly lessened by the *Diaphragma's* being pressed upwards, by which the Lungs were likewise much compressed, and they adhered in several Places to the *Pleura* and *Mediastinum*.—The Heart was of a paler Colour than common: From the Middle to its *Apex*, it was pressed flat, and there was little or no Water to be found in the *Pericardium*.

XI. *An Observation by Mr. William Watson, F. R. S. of Hydatides voided per Vaginem.*

A Gentlewoman aged about 48, the Mother of many Children, after a Respite of Six Years, had, in *November* 1739. the Symptoms of Conception, which left her in *February*; from which time to the End of *March*, she every Night discharged *per Vaginem Uteri* a considerable Quantity of Blood; and, not perceiving an Increase in her Belly, nor (which in

Cases of Conception is the *Pathognomonic* Sign of (something preternatural) her Breasts, she concluded her *Menses* were leaving her at their usual Period. But, upon the First of *April*, being taken with great Pains in her Back, and having other Symptoms antecedent to Delivery, there came away, at short Intervals, a very large Number of *Hydatides*, of all the intermediate Sizes, from a Nutmeg to a Pin's-head, some filled with clear, others with bloody *Lymph*; all of them propagated in the manner of a Cluster of Grapes from a spongy Substance, answering the Purposes of a *Placenta*. After the Discharge of these, in a few Days she recovered her accustomed Health.

Upon boiling some of these *Hydatides*, they appeared like the *Ovary* of a boiled *Hen*, with this Difference; in the *Hen*, the Contents of the *Ova* concrete; in this Case, not; but the Transparency was changed to the Colour of Bile diluted with Water.

XII. *Two Medico-Chirurgical Observations, by Monsieur Le Cat: Communicated in a Letter to Mr. Serjeant Amyand, dated at Rouen, Feb. 10. 1740. N.S. Translated from the French by T.S. M. D. F. R. S.*

I. *An Observation on Hydatides, with Conjectures on their Formation.*

September 21. 1739. a Woman died in our *Hôtel-Dieu*, who had an *Abscess* in the Right *Hypochondrium*, through which she discharged *Hydatides*; with

with a considerable *Tumour* at the Left *Hypochondrium*.

Her Body was opened. The *Abscess* of the Right *Hypochondrium* was between the common and proper *Membrane* of the Liver. The *Tumour* on the Left Side was almost as thick as one's Head, and twice as long. It was between the common and proper *Membrane* of the Spleen. It ran between the floating Parts of the *Abdomen*, had displaced them, and went so far as to push against the Integuments of the Belly, in its Passage adhering to the Stomach.

I laid this *Tumour* open, and found it filled with *Hydatides* of all Sizes, with clear Water, and mucilaginous *Membranes*, which were the Remains of large *Hydatides*, that were bursted by the Motions of the Patient. I examined with Care both the *Hydatides*, and their Bag: The *Hydatides* were composed of Two mucilaginous transparent, and yet very elastic *Membranes*. The inward *Membrane* had on its concave Surface a sort of Villofity wrinkled and mamillated, that pretty much resembled the Surface of a rough Skin, or what is called a *Goose's Skin*. The softest and most gelatinous of these *Membranes* were very like the vitreous Humour of the Eye. The Water contained in all these *Hydatides* was intirely like the aqueous Humour of the Eyes.

There were Clusters of these *Hydatides* quite resembling the *Ovary* of a *Hen*, or a Bunch of *Grapes*, which were made up of Globules of all Sizes.

The Bag that contained these *Hydatides* was pretty smooth on the Side opposite to the Spleen; that is to say, that Part of the Bag formed by the common *Membrane* of the Spleen, or by the *Peritonæum*, was pretty

pretty smooth; but on the Side next the Spleen, the Bottom of the Bag was very thick, and composed of several *Lamellæ* half destroyed, which fell off in Bits or Scales, and in Slime, at the least Touch.

It appeared plainly upon the Inspection of these Remains of the Bottom of the Bag, that that was the Source of the *Hydatides*; and, upon considering what Sort of Parts are found on the Surface of the *Viscera*, under their Integuments, it seems evident to me, that these lymphatic Globules were nothing else but *the glandulous and lymphatic Grains of the Surface of the Spleen, dilated into Excrescences by the Disease, and puffed up by the Lymph, which the Distemper caused to accumulate therein.*—And thus I conceive this Effect to be produced.

Proofs. I have proved in my *Physiology*, which is actually in the Press, that these glandulous Grains are nothing but the Ends of the Nerves, or nervous *Papillæ*, which receive the Ends of the lymphatic Vessels into their spongy Texture: And I have, among others, instanced in the *Papillæ* of the Tongue, called *glandulous Papillæ*, which are at the same time the Organ of Taste*, and the Receptacle of the salival *Lymph*.

A Part of the Nerves, which are distributed into the Substance of the Liver and Spleen, terminate in the Surface of those *Viscera*, under the Form of glandulous or pulpous Grains. This same Surface is the Seat of a great Number of *lymphatic Vessels*: And it is not to be doubted but those glandulous Grains are as necessary for those *Lymphatics*, as the *parotid*

* See his *Traité des Sens*, Rouen, 1742. 8vo.

Gland is necessary for the *Lymph* of the *salival Duct*, and the *glandulous Papillæ* of the Tongue for the Liquor that distils from them. In Quality of *Glands*, they are the Receptacle of those Liquors: As *nervous Papillæ*, they furnish the Spirits necessary for the Functions of those Liquors. All these Truths are proved in the Work above-cited. Let us now come to the Consequences of this Structure.

As long as the *glandulous Papillæ* are sound, their excretory Pores pour forth the *Lymph* according as their Cavities receive it from the *Lymphatics*: But if these Pores happen to be obstructed by a Disease; if the Surface of these Grains is altered by any Erosion; or if the natural Tone of these Solids is perverted; the *Lymph* brought into these Grains will be retained therein: It will stretch these Globules; their Substance, having lost its Elasticity, will easily give way; the nutritious Juice, which they will not be able to drive farther, will be there assimilated, and will contribute to the Dilatation. In fine, a Vesicle will be formed filled with *Lymph*, or an *Hydatide*, such as those we have examined.

This Congestion of *Lymph*, or *Hydatides*, will not fail to soften, relax, and raise up the *Membrane* that covers them; and thus a Bag will be formed like that which we found.

When an *Hydatide* swells to a considerable Size, the Volume of the Fluid will become disproportioned to the Force of the Teguments; these will be burst by the Shaking of the contained Fluid, upon the least Motion of the Body. This Fluid will extravasate into the common Bag, upon opening which the Waters and *Membranes*, which result from that Rupture, will be found.

Most Part of the glandulous Grains are distributed into Clusters, as is well known to Anatomists; wherefore *Hydatides* will also be found disposed in Clusters, like *Ovaries*.

Yet the greatest Number of this Heap will be composed of separate *Hydatides*; because, when one of these Globules has acquired a certain Bulk, it will generally break the too feeble Pedicle, which held it attached to the Cluster; and thus it will fall into the common Cavity.

This kind of Eruption, or general Disengagement from the Surface of the Bowel, must destroy its natural Texture, and reduce it exactly to the State in which we found the Bottom of the Bag of *Hydatides*, that were the Subject of this Observation.

2. *An Observation on the singular Consequences of an incomplete Hernia, and on the Functions of the Intestines exposed to Sight.*

C*Atharine Guilmatre*, of *St. Adrian*, near *Rouen*, aged 50, had a Rupture in the Right Groin, for Seven Years last past. At *Easter* 1739. there happened a Strangulation in her Rupture; and, having no Assistance, the *Tumour* suppurated, and opened of itself. The Excrements followed the *Pus*, and the Patient escaped at the Expence of Vomitings, and a little Fever.

The *Intestine* cicatrized with the *Integuments*, but there remained externally an Opening, through which the Excrements passed. The *Anus* ceased to perform its

its usual Functions; and, that excepted, the Patient was cured.

Towards *Whitsuntide*, there issued out at the Wound, besides the Excrements, a Gut Three or Four Inches in Length; but this Gut was turned Inside out, that is, the villous Coat was outward, and it conveyed no Excrements; these were always discharged through the Wound, on one Side, and below the Gut that was come out.

In the Month of *August* of the same Year 1739. there came forth at the Wound another Gut, turned as the First, making with it a continuous Canal, but at its End supplying *Fæces*, which had before been discharged through the Fistula; so that, instead of the Fistula, there was found, as it were, the Trunk of Two *Intestines*, which made a kind of Fork, as appears in Fig. 1. 2. and 3. TAB. IV.

The Woman, tired of this Inconveniency, resolved at length to seek Relief. Fortune presented her with no other than the *Hôtel-Dieu* of *Rouen*. She was brought thither in *December*. I was then in the Country: She was told, that her Distemper was incurable; and yet she was kept there till my Return, to shew her to me by way of Curiosity.

In Effect, I found her Case deserved my utmost Attention; and I had her carried to my House, in order to examine it more at Ease, and to have Drawings taken of her Distemper, as may be seen in Fig. 1. 2. and 3.

What was curious in this Distemper, was not an *Anus* formed contrary to Nature in the Groin (that Accident is pretty common); but it was the Two Guts turned Inside out, their villous Coat, and their

Functions, demonstrated to the very Eye; as also the *Enigma* occasioned by these Two Guts, which were both of one Piece, as appears in Fig. 3. TAB. IV. and which notwithstanding had Two Openings, the lower whereof voided the Excrements, and the upper discharged nothing. I know of no other Person but Mr. *Chefelden*, who has observed an inverted Gut in a living Body: But my Observation adds to his, 1st, Experiments on the Action of Purgatives: 2^{dly}, The singular Figure of this *Hernia*, the Discovery of which has an Influence on the radical Cure of this Disease, and on those of the same kind which may possibly happen, as will be seen by the Sequel.

I think I may give the Epithet of *Singular* to this sort of *Hernia*; because, upon Inspection, one instantly conceives, that the Gut which voided the Excrements was continuous to the Stomach, and the other to the *Anus*. But how was it possible, that these Two inverted Guts should be of one Piece? Let one imagine a Gut cut through by a Strangulation: There remain Two Orifices, one that runs to the Stomach, the other to the *Anus*: If the Canal of each of these Orifices turns inside out, and prolapses, as it happens, to the *Anus*; you then have Two Guts prolapsed and turned, but they are distinct one from the other, far from being of one Piece. It must be allowed, that the *Enigma* is puzzling: And indeed, a good Number of Surgeons saw this Singularity, but not one of them accounted for it. The Reader, if he be an Anatomist, has but to attempt the Solution, in order to be sensible of the Difficulty. The Figures, TAB. IV. annexed to this *Transaction*, perfectly resemble Life, only somewhat contracted.

The

The villous Coat, and the Functions of these *Intestines*, being exposed to the Eye, afforded a Circumstance still more curious and useful. These Two Portions of Guts seemed to be Two large living Worms. They move here-and-there, twisting, shortening and lengthening themselves like Reptiles. The lower Gut was much more alive, and sounder. One time that I handled it, it twisted round my Fingers like an *Eel*. The upper Gut, that answered the *Anus*, had less Motion, and was beset with Pustules.

The Expulsion of the *Fæces* engaged our particular Regard: We remarked in its Mechanism Two Sorts of Motion.

The First is the vermicular Motion, allowed by most Authors. In this, the Gut first swells, and becomes smooth; then grows narrower, running into Wrinkles, and forming Waves the whole Length of the Gut, where these Two Motions happen alternately. The Streightening is performed behind, and upon the Excrements, to drive them down; the Dilation happens before these *Fæces*, in order to open them a Passage: For Example: When the *Fæces* were at the Orifice, through which we saw them issue, this Orifice was spread open.

The Second Sort of Motion that we observed in the Guts, generally preceded the one above described. In this Motion the Surface of the Gut, being swelled and smooth, was rendered uneven by many small Impressions [or Hollows] distributed here-and-there, and which seemed to be formed by little local Convulsions, circumscribed by the *intestinal Fibres*. These convulsive Impressions resembled, in little, those that are made in the *Abdomen*, upon contracting some one

of its *Muscles*. They made the Surface of the *Intestine* a little pale, and thereby formed a sort of Undulation on its Surface. It was chiefly in this sort of Motion, that there was squeezed out of the villous Coat of the *Intestines*, a Mucilage and Serosity, which flowed from it in Abundance. Both these seem to serve for diluting the *Fæces*, and preparing them an easier Passage. The cold Air did not fail to excite these Motions, and the Woman felt some Touches of the Colic.

After having made these Observations on the natural Functions of the *Intestines*, it occurred to my Thoughts to observe the Effect of Cathartics therein. One does not often see the Inside of the Guts of a living Person in good Health, and freely performing his Functions: Wherefore I was willing to make use of so uncommon an Occasion.

First, I put a little Pulp of *Cassia* on several Places of these Two Portions of Gut. This Medicine made very little Impression on those Parts; they stirred very little, especially the upper Gut.

Next, I laid on *Manna*. This, when somewhat dissolved; formed a sort of Froth, and then the Gut was agitated by vermicular Motions, and by small convulsive Contractions, much more distinct than in the Conditions I had examined it before.

I took off the *Manna*, and strewed Powder of *Jalap* on the Gut. At first it had no Effect; but, when it was moistened, the Gut was violently agitated, discharged much Serosity, and the Patient complained of Gripings. I removed the Powder, and under it I found a great Quantity of Mucilage, that was already gathered there.

I thought it needless to harraſs this Woman by further Trials, which would prove much the ſame with the foregoing ; and therefore turned my whole Attention on the Means of curing her of this Accident, and thereby rewarding her for the Services ſhe had rendered us.

At firſt Sight of this Diſeaſe, I was as far as the other Surgeons from comprehending the *Ænigma* of the Figure of the Two Ends of the Gut continuous [or of one Piece.] I plainly ſaw, that they were Portions of the *Ileum* ; but I was obliged to meditate on it a ſecond time, in order to gueſs at the reſt ; and yet nothing ſo eaſy when a Perſon has hit it off.

*The Nature
of this Accident
explained.*

The *Hernia* which this Woman had at firſt, was one of thoſe named an *incomplete Hernia properly ſo called* ; that is, a *Hernia* wherein there was but a Portion of the Side of the Gut pinched within the Ring. This ſtrangulated Portion mortified ; the ſound Lips cicatrized with the *Integuments* ; the reſt of the Canal remained within the Belly ; and the Excrements, which this Remainder of the Canal received, iſſued at its Outlet towards the Groin.

The Patient, being recovered, quitted her Bed, and by little and little occaſioned the turning Inſide out, and Fall of the Portions of the inteſtinal Canal, ſituated above and below the open Part. By this Inverſion, the remaining Coats of the opened Gut came out likewise. This Part is ſituated between the Two Portions, one of which answers to the Stomach, and the other to the *Anus* ; and with theſe Two Portions it makes but one and the ſame Part, or a continued

tinued Plane: Wherefore it was found, out of the Belly, between these Two Portions, and formed, as it were, the Trunk of these Two Branches.

The Portion, or Branch, corresponding with the *Anus*, must have had less Motion, and be less sound; because it is deprived of the Share of Life that would come to it from the Continuity of the *Fibres* that were pinched and carried off by the Strangulation, and that it is continually exposed to the Air. The other Portion is full of Life, because its Continuity with the Stomach makes it enjoy all the Life that this Communication can furnish it with; and that besides it remains within the *Abdomen*, while the Patient is in a recumbent Posture.

In order to give the Pupils of our *Hôtel-Dieu* a clear Notion of the Formation of this singular Rupture, I made one just like it on a dead Body. For that Purpose I made an Incision in the *Abdomen*, at the Place of the Rings. I passed into it a Gut, in which I made an Opening. I sewed the Lips of this Opening to those of the Wound of the Belly; and having turned Inside out the Portions of Gut placed above and below this Opening, they afforded us a Bifurcation of Guts continuous and intirely like that of the Observation.

Method of curing this Accident. A Disease well known is sometimes half cured. This same Portion of Gut that supplied the *Fæces*, and that was so lively, was drawn back into the Belly, when the Patient lay down, as I have already said; and the other only constantly continued out. This Circumstance made me conceive Hopes of curing this Accident.

Thus

Thus I reasoned with myself: It is but first making this last Gut enter in, and bringing the Disease to its first State: Then, seeing there is a pretty large Portion of a Canal still remaining between these Two Guts, as appears by the Bigness of the Trunk of the Branches formed by them; what remains to be done, after the Whole is reduced, is to close the exterior Orifice of this demolished Canal; that is, to close the Opening made by the Strangulation and Mortification; and I conceive, that this last Operation is very feasible. The next thing to be done is to refresh the Lips of the Fistula formed by the Integuments of the *Abdomen*, which are thick enough, and on which shall be afterwards made a *Gastrophia* proportionate to these Parts.

The great Difficulty is, to reduce this End of Gut, which is grown hard, and full of Tubercles. I have already made a fruitless Attempt, both with Cataplasms to repair the Damages, and with manual Operations proper for making it re-enter. I am actually watching a favourable Moment for this Operation. If I succeed, I intend to stay for making a second Operation, till this Gut has remained long enough in the Belly to repair itself, and resume its Functions. In order to that, I shall content myself for the first Eight Days, with keeping it in the Belly, applying resolving Fomentations, and giving proper Clysters. Then will I put into the Opening of the intestinal Canal, that answers to the Fistula, a silver *Canula* of the same Bore with the Gut; in order to push this Portion of a Canal into the Belly, to support it therein, and re-establish its Communication with the Portion newly reduced. This silver *Canula* will be
fixed

fixed by a Plate of the same Metal, guarded with Plaster and Linen, and placed on the Fistula, where it shall be secured in its Situation by a Bandage. I shall then redouble the Use of the Clysters, and when I shall be ascertained of the Re-establishment of the Communication of the Two Guts, and the Functions of the Portion continuous to the *Anus*; then I will withdraw my silver *Canula*, and will perform the Operation, as I have said above.

EXPLANATION of TAB. IV.

Fig. 1. The Woman with the *Hernia* in *Situ*.

Fig. 2. The *Hernia* represented at about half its natural Size.

A. *The lower Part of the Intestine communicating with the Stomach, and emitting the Excrements.*

B. *The upper Part of the Intestine, which is continued down to the Anus, and emits only Mucus, and serous Humours.*

Fig. 3. The upper Part of the *Intestine* raised up, that the Connexion of these Two Parts of the *Intestines* may the better appear,

XIII. *Some Remarks concerning the Circulation of the Blood, as seen in the Tail of a Water-Eft, through a Solar Microscope, by the Rev^d Mr. Henry Miles; communicated in a Letter to Mr. John Eames, F. R. S.*

S I R,

I Well remember the great Satisfaction you expressed in the Microscope made by Dr. *Lieberkuhn*. This induced me to communicate to you an Experiment I have made once and again, with one of the same kind, made by Mr. *Cuff* in *Fleetstreet*.

I had been eagerly wishing for an Opportunity to attempt to see the Circulation of the Blood in this Way; and for that Purpose got some *Gudgeons*, which I kept Two Months in Water, this Winter, waiting a favourable Day; but I did not succeed well, though I saw it plain enough to convince me, that it was worth while to attempt it in a better Subject; for I find the Fins of Fish to be of a cartilaginous Nature, have few Vessels, and those small.—But the *Lacertus Aquaticus* of Mr. *Ray*, commonly called the *Water-Eft*, having a Tail that seems to be much softer, and of a fleshy Substance, and abounding with large Blood-vessels, is excellent for this Purpose. Having procured me one of the lightest Colour, and most transparent, I put it into a glass Tube, of a Bore just big enough to receive it; the smaller the Tube, the better, provided you can get it in without injuring it. When I had fixed the Tube in the Body of the Microscope, I

5 B

found

found the exact *Focus*, before I placed the Microscope on the Tube which receives and conveys the Sun's Rays to the Animal ; and, having darkened the Room as much as I possibly could, I had a most entertaining Sight of it on my Paper Screen, at the Distance of Three and Four Feet.—The Magnifier I used was the Fourth in *Wilson's* Pocket Microscope.—And at the Distance of Six or Seven Feet, but not so distinct—You have in the Paper which accompanies this (see TAB. V. Fig. 1.) the exact Dimensions of the Field of Vision (as I call it), taken with a black Lead Pencil, on the Sheet of Paper which was strained in a Frame on purpose, at the Distance of about Three Feet $\frac{1}{2}$ from the *Focus*. You have there the true Dimensions of one of the larger Vessels, not the largest, which, being near the Middle of the Tail, appeared but obscure. And I have added the Dimensions of one, the Screen being removed to Six or Seven Feet Distance.

In the larger Vessels, the Motion seems to equal that of the Stream of Water which is forced out of a Vessel by condensed Air ; and makes an Appearance not altogether unlike it, when the Fountain is placed in the Sun : Here you can discern no Shape or Form at all of the Globules, but they seem all confounded : As the Current proceeds, you have beautiful luminous Reflexions continually. But in the lesser Vessels, and in the Parts most free from Spots, I several times saw the Globules of an oblong Form, resembling *Emmets Eggs* in Shape, which I have endeavoured to represent in the Paper, gliding along one after another, and often at the Distance you see them in the Figure, sometimes joined together ; but I have
never

never yet been able to discern any Commixtion of them. I do not remember ever to have seen the Globules to approach this Form, in viewing the Circulation in the common way; but here every thing is magnified to that Degree, that the least Departure from the globular Form appears plainly. Another thing I observed, more than once, with Pleasure; that the Globules would, in some Places, gradually slacken their Motion, at length seem to be about to stand still; in an Instant, a Globule would be compressed, in the Manner I have endeavoured to describe it in the Paper; and then, as if it had squeezed through a narrow Passage, resume its former Shape, and pass on with great Swiftness.—

But the most remarkable *Phænomenon* of all was, the Shape and odd Motion of some of them, near the Extremity of the Edge of the Tail—which exactly resembled the *Tadpole* in Figure and Motion too, abating that they had not quite so much of the wriggling Motion of the Tail of those Creatures in a Pond of Water; but the Head (as I call it, for Distinction-sake) had exactly the same Motion. They seemed to be roaming about, as if in Quest of somewhat; would turn to the Right and Left, and sometimes seem to be repulsed a little, or to draw back of themselves, as I have seen the *Animalcula* in *Pepper-water* do. I have endeavoured to describe the Figure of them; the Motion has all the Resemblance that can be of that of the Animals mentioned.—I began to suspect at first, they might be *Animalcula*, contained in the Water out of which the *Lacertus* came, which might remain in the Tube, under the Tail: But, on Examination, I found it dry; for indeed the Creature

had been out of Water half an Hour, or more, and had been handled (which I scruple not to do), and so was drained well; so that I am certain the Appearance was in the Vessels of the Creature, though I would not be so rash as to suggest they were real *Animalcula*; for I presume the Figure and Motion may be accounted for, without supposing them to be any other than Globules of Blood, from the State in which the Blood might be, and from some Alteration of the State of the Vessel itself: The Blood, indeed, seemed to be about stagnating; but this I submit to your Judgment, who are so well acquainted with the Laws of *Hydrostatics*.—It came into my Head, that I had seen a Drop of Water proceed somewhat like it, in its Descent on a smooth dry Surface (as a glass Plate held nearly perpendicular); and, on Trial, I found the Drop to proceed in a kind of *Meatus*, not altogether unlike the Motion of the said Globules. In the Course of the Blood from *A* to *B* (see Fig. 2. TAB. V.) sometimes a Current would turn off to the Branch at α , for a good while together, then cease to do so, passing on to *B*; and leaving the Branch α empty; and then again you might see it fill the Branch again: This I saw successively several Minutes together. If you think this worth communicating to the ROYAL SOCIETY, as an Experiment capable of Improvement by Persons of more Leisure, and better Skill, it is at your Service.

I would only mention to you some of the Difficulties I met with, and tire you no longer.—

At first it was no easy Matter to make a Creature, coming out of so cold an Element, bear even the reflected Rays of the Sun, when converged, though
far

far enough from the *Focus*; for I was obliged to make use of a Looking-glass because of the Sun's Position: I once, indeed, tried to perform it without, but found the direct Rays too hot; but a Glance or two I had of it, convince me it might be seen to much greater Perfection.—Another Difficulty is, that the Tube is rather too thick, and besides is apt to be smeared with the Tail of the Animal: However, it requires Time and Patience to perform it; yet, in the Manner I have seen it, it is to me the most entertaining Sight my Eyes ever saw.—I am not without Hopes, that I shall be able to remove some of the Difficulties myself, if GOD give Health and Opportunity this Summer; if not, I wish a fitter Person may attempt it, and succeed: It may be useful, perhaps, as well as pleasing. I am

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Tooting, March 31. 1741.

Your most obliged,

and humble Servant,

H. Miles.

I forgot to mention, that the Blood appeared a little discoloured, but not more in Proportion than it appears to be when you view it in the common way; and that the Tube, with the *Lens* receiving the Sun's Rays, was exactly parallel with the Horizon, and perpendicular to the Plane of the Screen which received the Image.

XIV. *A Letter from the Rev^d Ebenezar Latham, V. D. M. and M. D. to C. Mortimer, M. D. S. R. S. concerning the true Delineation of the Asterisms in the antient Sphere.*

S I R,

I Was obliged, by the Favour of yours, with Number 447. of the *Transactions*, by which I find we have the Globe of the Heavens already contrived for the Use I intended. I never heard of Mr. *Senex's* Invention, *ib.* N^o 447. before the Hint yours gave me, and am pleased with the Opportunity I had of producing it to the World. It is many Years since I first thought of this Method, and have often suggested it to some Students. The Dispute that arose about Sir *Isaac Newton's* Chronological Index, communicated by Abbé *Conti*, confirmed my Opinion of the Advantage that would attend it; especially the Admonition our learned Dr. *Halley* gave Father *Souciet*, (“to inform
“ himself in the *Sphæriques*, so as to give us the right
“ Ascension of the Stars truly from their given Latitude and Longitude”) made me yet more sensible how necessary something of this kind was, to let common Readers into the Merits of the Controversy. But it was perfectly accidental, that I ever presumed to mention at all to your *Learned Body*, this Alteration in the Construction of the Globes, which I had so often wished might obtain for the Use of several Sciences. You will receive, with this, one Scheme,
among

among several, which I have projected, that is nearest Mr. *Senex's*, and least defaces the Globe, which I submit to your Judgment, as to the Conveniences that attend it.

T A B. VI.

Fig. I. A Vertical Section of the Globe.

P. P. *The Poles of the diurnal Motion.*

A. *The Axle of the Globe, which terminates in the Poles of the Ecliptic, and receives the other End of the Brass Arms upon each of its Pivots.*

Æ. *A brass Equator fixed to the brazen Meridian.*

K. K. *A Key, which, on Occasion, being put through a Hole in the Brazen Meridian, is just over the Place where the Poles of the Ecliptic pass, by means of a square Hole in the Head of a Screw, serves to fix that End of the Brass Arm, or give it Liberty to move with Ease: And the Key, being left in when the Screw is slackened, will hinder the Globe from moving on the Poles of its diurnal Motion, till you have adjusted it to your Mind, straitened the Screw again, and taken out the Keys; as may be seen more plainly in,*

Fig. II. Which is nothing but the Windlass Part, or the Arm, Pole, and Part of the strong Axis of the Globe, with the Screw and Key more at large, and separate from one another for the more distinct View.

If

If I may take the Liberty to add any thing farther on this Head, next to the accurate Observation of the *British Catalogue* in placing the Stars themselves, it should be the Revival of the *antient Figures* and *Colours*, as far as we can recover them. It is certain the Invention was very antient, if we suppose the Descriptions *Eudoxus* has given us, taken from Observations long before his Time, when the Solstitial Colure passed through the Middle of the *Great Bear*, and the *Crab* through the Neck of *Hydra*, and cut *the Ship* between the Poop and the Mast, &c.—Now I have mentioned *the Ship*, you will indulge a Conjecture, that the Situation of this [just on the Horizon (where they imagined the Sea) in an erect sailing Posture for some Eastern Expedition, and terminating their farthest View to the South], may both give some Light into their *Latitude*, that imposed this Name, and (from that, which must have been the Place of the Pole to answer this Form) *the Era of Time*, wherein it was done; for, in the present Disposition, the Inhabitants of *Greece* could not have a proper View of that Constellation, or be led to form it in the Manner the Antients have done. I shall not here urge all the Difficulties in the old Descriptions, that might have a Solution from this Method; but if an Alteration could be made either in the *Colour* or *Attitude* of the *Figures*, to answer them better, it would add to the Pleasure of reading some Authors, and, together with that new Construction, might afford us such a View of the Heavens, as Mr. *Addison* had of *Italy*, when he made the Tour of it with the Classics in his Hands: And, since I have brought those Writings into the Account, you will allow

allow me to cite some Passages, which might receive both *Truth* and *Beauty* from such an Improvement: Where *Homer* says,

Πληιάδας δ' Ἰάδας τε, τό τε δίνος Ὀρίωνος,
Ἄρκτον δ', ἣν καὶ ἄμαξαν ἐπικλησὶν καλέουσιν,
Ἦτ' αὐτῷ γρέφεται, καὶ τ' Ὀρίωνα δοκεύει,
Οἷη δ' ἄμμορος ἐστὶ λοστρῶν ὠκεανοῖο.

Iliad. Σ. 487.

The *Pleiads*, *Hyads*, with the Northern Team,
And great *Orion's* more refulgent Beam;
To which around the Axle of the Sky,
The *Bear* revolving points *his* golden Eye,
Still shines exalted on th' ethereal Plain,
Nor bathes *his* blazing Forehead in the Main.

Pope.

Mr. *Pope*, amidst a small Mistake of the *Sex*, keeps only the Forehead above Water; but the Poet seems to exempt her intirely; and so does *Virgil*, when he makes *Fear* account for the same *Phænomenon*, that *Ovid* (who preserves all the Fable of the Antients) ascribes to *Force*.

Maximus hic Flexu sinuoso elabitur Anguis
Circum, perque duas in morem fluminis Arctos:
Arctos Oceani metuentes Equore tingi.

Virgil. Georg. Lib. I. 244.

Around our Pole the spiry *Dragon* glides,
And like a winding Stream the *Bears* divides,
The Less, and Greater, who by Fate's Decree
Abhor to dive beneath the † *Southern* Sea.

Dryden.

† Northern.

*Nuper honoratas summo mea Vulnera Cælo
Videritis Stellas illic, ubi Circulus Axem
Ultimus extremum Spatioque brevissimus ambit.*

Ovid. Met. Lib. II. 515.

—————New Stars you'll see,
In this approaching Night's Obscurity,
With hateful Beams i'th' *Arctic* Circle shine.

He immediately adds,

*At vos si læsæ contemptus tangit Alumna,
* Gurgite cæruleo septem prohibete Triones:
Sideraque in Cælo stupri mercede recepta
Pellite, ne puro tingatur in Equore Pellæx.*

—————527.

Ne'er let those spurious Stars approach the Deep,
Nor in the purging Ocean's Bosom sleep, [keep.]
But their eternal Stain, their whorish Tincture

And when he describes them as a Team, it is with
the same Reserve.

*Tum primum Radiis gelidi caluere Triones,
Et vetito frustra tentârunt Equore tingi.*

—————171.

Then the Sev'n Stars first felt *Apollo's* Ray,
And wish'd to dip in the forbidden Sea.

All which is a proper Hint for the *Disposition of
the Globe*, that must correspond to these *Appearances*

* In the *Ordeal* by Water, it was adjured, not to receive the Guilty,
in Terms like these.

then,

then, and which can only be obtained by this Method: By the Help of which we may also apprehend the Light these Descriptions give us *into the Age of the Writers*. I may illustrate this from *Hesiod's* Account of *the Seasons*, of which we have not only a better Idea by this artificial Disposition of the Globe to answer them, but also of *the Time* wherein he lived, when we come to adjust the Heavens to the accurate Instructions he gives us, according to his Latitude at *Ascrea*, allowing 30'' *per Annum* for the apparent Motion of the Stars.

Εὐτ' ἂν δ' ἐξήκοντα μὲν τροπὰς ἡελίοιο
 Χειμέρ' ἐκτελέσῃ Ζεὺς ἡμαλῖα, δὴ ῥα τότε' ἄστ' ἔρ
 Ἀρκιῦρον περιπλῶν ἱερὸν ῥόον ὠκεανοῖο,
 Πρῶτον ὠαμφαίνων, ἐπιτέλλεται ἀκροκνέφαϊ.
 Ἡσιόδ. Ἐρλ. Βιβλ. 6'. 182.

When the glad Sun, approaching with his Rays,
 Has from the Tropic run out Sixty Days;
Arcturus, rising from his sacred Bed,
 Is first discover'd in the Ev'ning Shade.

Εὐτ' ἂν δ' Ὀρίων καὶ Σείρα εἰς μέσον ἔλθῃ
 Οὐρανόν, Ἀρκιῦρον δ' ἐσίδῃ ῥοδοδάκτυλ' Ἥως. 227.

But when *Orion*, and the *Dog-Star*, come
 To the Mid-region of the heav'nly Dome,
 The Morn, that blushing draws away the Night,
 Beholds *Arcturus* in the dawning Light.

If we fix the Pole almost in the Mid-way between the Star in the Shoulder of the lesser *Bear*, and another of the *Serpent*, we shall have the Satisfaction to observe all these *Phænomena* answer the Descrip-

tion. I shall not enter into the Calculation ; for I would not anticipate the Pleasure, one, that hath no Notion of the Age of *Hesiod*, must have, when he finds himself able, with so much Ease and Precision, to determine it by these Characters *.

Hesiod's Account of the *Pleiads* is too particular not to demand our Attention, and require an Explanation in the same way †.

Πληιάδων Ἀλφεινέων ἐπιέλλομενάων

Ἄρχεω' ἀμνητῷ, ἀρότοις δ' ὀυσομενάων.

Ἄι δὴ τοι νύκτας τε καὶ ἡμέρας τεσσαράκοντα

Κεκρύφαίαι.

Ἡσιόδ. Ἑρλ. Βιβλ. ε'. ι.

Be-

* Since I wrote this, I had the Pleasure to find *Scaliger* concur with me—

Hesiodus florebat eo Sæculo, quo Arcturus ἀκρόνυχος oriebatur in Bæotia, viij Die Martii. Si quid loc ad Conjecturam facit, saltem apud excellentes Astrologos, qui ex hoc Parapegmate infra septuaginta plus minus Annos Sæculum Hesiodi deprehendere possunt. Animadvers. in Chron. Eusebii, p. 67. Edit. Lugd. Batav. 1606 —

The following Passage in Sir *Isaac Newton's* Chron. p. 95. hath come to my Hands since the former. “ *Hesiod* tells us, that, 60 Days “ after the Winter Solstice, the Star *Arcturus* rose just at Sun-set ; “ and thence it follows, that *Hesiod* flourished about 100 Years after “ the Death of *Solomon*, or in the Generation or Age next after the “ *Trojan War*, as *Hesiod* himself declares.”

'Tis what we may compute by the present Globe ; for, bringing *Arcturus* to the Eastern Horizon, the Sun we shall find in the Ninth Degree of *Aries*. Now it enters *Dec. 11*, and 60 Days after, or *Feb. 10*. it is in $\text{H } 20^{\circ} 30'$. when allowing for the Northern Latitude of *Arcturus* to make it visible on the Horizon, its Longitude must have been $\text{W } 14^{\circ} 58'$. whereas its Place now is about $\text{E } 20^{\circ} 27' 12''$. And the Difference both ways one Sign $6^{\circ} 18'$. &c. which makes him to have lived 2614 Years ago.

† Hisse Signis veteres Agricola, & ex eorum Traditionibus Scriptores rei rusticae, nec non & Medici, Poetae, & Historici sunt usi ad Anni Tempestates designandas, &c. *Grieg Astron. p. 130.*

Begin the Harveſt, as the *Pleiads* riſe, [Skies;
And take the Plough, when they withdraw the
For Forty Days and Nights their glimm'ring Light,
Obſcur'd to us, no longer cheers the Sight.

To this I might add *Homer's* Image of the *Dog-Star*, but eſpecially the exact Deſcription in *Hefiod*.

Ἄστὴρ ὁπωρενῶ ὀναλίνχιον, ὅς τε μάλιττα
Δαμπαρὸν παμφαίνησι λελαμένῳ ὠκεανοῖο. Ἰλιάδ. Ε'. 5.

Like the red Star, that fries th'autumnal Skies,
When freſh he rears his radiant Orb to Sight;
And, bath'd in Ocean, ſhoots a keener Light.

— — δὴ γὰρ τότε Σείριον ἄστ' ἦρ
Βαῖν ὑπὲρ κεφαλῆς κηλίρεφών ἀνδρώων
Ἔρχεται ἡμάτιος, πλέον δ' τε νυκλὸς ἑπαυρεῖ.
Ἡσιόδ. Ἐρξ. Βιβλ. β'. 35.

For then the *Dog-Star* governs in his Courſe,
Walks o'er the Heads of Men, who feel his Force,
Comes in the Day, but chiefly ſhares the Night.

How beautifully does the ſame Writer expreſs the
Geſture of *Orion*, as he is following the *Pleiads*?

Εὖτ' ἂν Πληιάδες ὤϊενος ὄβριμον Ὠρίωνος
Φεύγασαι, πτόπιωσιν ἐς ἠεροειδέα πόντον. 237.

The *Pleiads*, flying from the threat'ning Scourge
Of ſtrong *Orion*, plunge into the Surge.

Perhaps this may give ſome Light to a Paſſage of
Virgil, that hath very much puzzled his Commen-
tators,

*Taygete simul Os terris ostendit honestum
 Pleias, & Oceani spretos pede reppulit Amnes:
 Aut eadem Sidus fugiens, ubi Piscis aquosi
 Tristior hybernas Cælo descendit in Undas.*

Georg. Lib. 4. 232.

First, when the pleasing *Pleiades* appear,
 And springing upward spurn the briny Seas:
 Again when their affrighted Choir surveys
 The watry *Scorpion* mend his Pace behind,
 With a black Train of Storms, and Winter-wind,
 They plunge into the Deep, and safe Protection
 find. *Dryden.*

Some, I know, by this *Sidus* understand the *Southern Fish*, others the *Hydra*, and some the *Sun*; but how Mr. *Dryden* came to insert *Scorpio*, I shall not inquire. Nor shall I trouble you with any Conjectures with regard to the *antient Figures*: It is certain there have been *Variations* in this respect, since *Ptolemy* mentions a Star in the Horn of *Aries*; and it is thought *Hipparchus* reckoned one, that is now in the Line, to the first Foot of *Aries* *. Whether the Epithet *Ovid* gives *Capella*, does not imply some little Difference, in the Situation of it, from ours, I leave to the Critics.

—Et

* Since I wrote this, I find Sir *Isaac Newton*, in this way, recover to their former Places the Stars below, by rectifying the Delineation.

“ In the extreme Fluxure of *Eridanus*, a Star of the Fourth Magnitude, of late referred to the Bosom of *Cetus*.

“ In the Head of *Perseus*, a Star of the Fourth Magnitude.

“ In the Right Hand of *Perseus*, a Star of the Fourth Magnitude.

“ In the Neck of *Hydrus*, a Star of the Fourth Magnitude.

“ In the Left Hand of *Cepheus*, one of the Fifth Magnitude.”

All whose Characters he designs from *Bayer*.

— *Et Olenix Sidus pluviale Capellæ,
Taygetenque, Hyadasque Oculis, Arctonque notavi.*
Met. Lib. III. 594.

— I began to note
The stormy *Hyades*, the rainy * *Goat*,
The bright *Taygete*, and the shining *Bears*,
With all the Sailors Catalogue of Stars.

I might insist on the Etymology of *Arcturus*, and others; for it appears from the Accounts the Antients themselves give us, there was not always the greatest Uniformity in their Drawings. *Ovid* says of *Bootes*,

————— *& te tua Plaustra tenebant.*
Lib. 2. 177.

Nay, and 'tis said, *Bootes*, too, that fain
Thou would'st have fled, though cumber'd with
• thy Wain. *Addison.*

And he lets us know, that *Scorpio* took up 60°.
Est Locus, in geminos ubi Brachia concavat Arcus
Scorpios; & Cauda, flexisque utrinque Lacertis,
Porrigit in Spatium Signorum Membra duorum.
————— 195.

There is a Place above, where *Scorpio*, bent
In Tail, and Arms, surrounds a vast Extent;
In a wide Circuit of the Heav'n's he shines,
And fills the Space of Two celestial Signs.

This might be one Reason of that Compliment
which *Virgil* paid *Augustus*, apart from the other,
which *Scaliger* assigns.—

* Elbow'd.

*Anne novum tardis sidus te mensibus addas,
Qua locus Erigonen inter, Chelasque sequentes
Panditur? ipse tibi jam Brachia contrahit ardens
Scorpius, & Cæli justa plus parte reliquit.*

Georg. Lib. I. 32.

Where in the Void of Heav'n a Space is free,
Betwixt the *Scorpion*, and the *Maid*, for thee:
The *Scorpion*, ready to receive thy Laws,
Yields half his Region, and contracts his Claws.

It's true, this Poet knew *Libra* very well; but, perhaps, it made no great Figure among the *Asterisms* then.

*Libra die somnique pares ubi fecerit horas,
Et medium Luci, atque Umbris jam dividet Orbem.*

—208.

But when *Astræa's* Balance, hung on high,
Betwixt the Nights and Days divides the Sky.

Dryden.

How *Taurus* was *painted* at that Time, we learn from his Description.

* *Candidus auratis aperit cum Cornibus Annum
Taurus, & averso cedens Canis occidit Astro.*

—217.

* By reason the First Month of the old Luni-solar Year (on account of the intercalary Month) began sometimes a Fortnight after the *Æquinox*. This may, perhaps, account better for the Propriety of *Virgil's* Expression *Aperit Annum*, than any of his Commentators have done.

When

When with his golden Horns, in full Career,
The *Bull* beats down the Barriers of the Year;
And *Argos*, and the *Dog*, forsake the Northern
Sphere.

In the last Verse we have, perhaps, no Occasion for *Heinsius's* Correction of *adverso*, if we compare the Diction here with *Ovid's*.

Per tamen adversigradieris Cornua Tauri.

Met. Lib. II. 80.

The *Bull's* opposing Horns obstruct the Way.

The Instructions *Virgil* gives in the same Place, as to Husbandry, are best understood from this new Disposition, and may render us sensible how much earlier these *Phænomena* were then in the Year, to what they are at present*.

• *Ante tibi Eoæ Atlantides abscondantur, &c.*

Georg. Lib. I. 221.

But if your Care to Wheat alone extend,
Let *Maia* with her Sisters first descend,
And the bright *Gnosian* Diadem downward bend. }

I know we cannot depend upon all the Exactness in a Poet, that might be expected from an Astronomer: But *Virgil* seems to have made it his favourite Study.

* *Paulatim Observatio hujus Ortus & Occasus neglecta jacet, nec ab aliis usurpatur, quàm à Poëtis, qui tempora per Circumstantias tan varii Ortus & Occasus tot Syderum (quibus nihil pulchrius) describere, & veluti pingere solent, quamvis plerumque erroneè, quippe qui Calendarii nostri Diem per ejusdem Stellæ Ortum describunt nunc, per quem describebatur tempora Cæsaris, cum tamen tempora discrepent 14 diebus ferè.* Greg. Astron. p. 132.

*Me vero primum dulces ante omnia Musæ,
Quarum sacra fero ingenti percussus Amore,
Accipiant; Cœlique Vias, & Sydera monstrant.*

Lib. II. 475.

Would you your Poet's first Petition hear,
Give me the Ways of wand'ring Stars to know.

Ovid appears also perfectly acquainted with the antient Figures, and the most accurate way of *delineating* them, at the same time that he enlivens them with their *Fictions*.

*Consistuntque Loco, Specie remanente Coronæ,
Qui medius nixique Genu, anguemque tenentis.*

Met. VIII. 181.

————— The Crown retains
Its proper Figure, and a Station gains
Where *Hercules* in bending Posture stands,
And strives to gripe the *Dragon* in his Hands.

Vid. Lib. XIV. 846.

How he came by the Account, it is not material to inquire; but there is *one Line*, wherein he seems to have preserved some antient Tradition, as to the *Pole*.

Quæque Polo posita est glaciali proxima Serpens.

Lib. II. 173.

The folded *Serpent* next the frozen *Pole*.

And there is Reason to believe *one* of the Stars of that *Constellation* was the *antient Polar Star*, and might first give Rise to the Denomination; for one in the *Tail of the Dragon*, of the *Third Magnitude*, comes nearest it of any other. About the Time of the *Flood*, it was within 10' of the *Pole*, and might
pass

pass for the *Polar Star* a Thousand Years after among those Writers, from whom *Ovid* copied his Expression. However, this is certain, that *another Star* of that Constellation, one of the Fourth Magnitude, was really nearer than any other, when the old *Observations* were made, which literally justifies *Ovid's Account*. I might take notice of his exact Representation of the Disposition of *the Ara*, and *Anguis*, when he makes them the Two Extremes.

————— *Medio tutissimus ibis:*

Neu te dexterioꝛ tortum declinet in Anguem,

Neve sinistroꝛ pressam Rota ducat ad Aram.

Inter utrumque tene.————— ib. 137.

The middle Way is best.

Nor where in radiant Folds the *Serpent* twines
Direct your Course, nor where the Altar shines.

•• Shun both Extremes.

But the Inspection of the Globe, when it is fixed in a proper Position, will convey the best Idea of all these Appearances; for we derive this Advantage from the new Construction of it, that it will enable us to place the several *Phænomena before every Eye*; by which means those who have the least Acquaintance with these Studies, must be greatly surpris'd and pleas'd to observe the antient Accounts minutely verified. It is a sort of living over again the former Ages, *allowing* $1^{\circ}. 23'. 30''$. *for every hundred Years*, according to *Ricciolus* and *Flamsted*, which is a sort of Mean between the other Computations.

I shall not now suggest some other Purposes, that might be served by this Method. It is sufficient to recommend the Invention, that it throws so much

Light on the common Classics, to which I have confined this Examination, and which must be my Excuse for the Citations. I am, with great Respect,

The ROYAL SOCIETY'S

and your most obedient

humble Servant,

E. Latham.

XV. *Lumen Australe Romæ observatum die*
27 Jan. An. 1740. a Didaco de Revillas,
Abbate Hieronym. P. Math. Prof. &
R. S. S.

COELO undique núbilo, notoque vehementer flante, hora post Meridiem 6^a. rubescens lumen inter gradus 45 & 55 amplitudinis ortivæ australis apparebat. Maxima ejus supra horizontem latitudo gradus circiter 9 æquabat. Parte tamen Coeli horizonti proxima ad unum circiter gradum obtenebrata spatium fere parallelogrammum gradus 10 latum, 8 altum lumini concedebatur; quod in suprema parte magis, minus in ima splendebat. Inter densiores nubes altera summe nigricans *AB* TAB. VI. Fig. 3. horizonti propemodum parallela, supra lumen, meridiem versus protendebatur.

Post horæ semissem vividius sensim micabat splendor; sensimque iterum minuebatur: quod pluries usque ad horam 9 observatum. Interim tenuis horizon

zoni

zonti itidem parallela nubecula *CD* lumen a meridionali plaga interfecans, comparebat. Circa horam 9 nubes aliæ ab orientali versus meridiionalem plagam paullatim procedentes splendorem jam languescentem obtegebant: & circa horam $9\frac{1}{2}$ penitus exinguebant. Post horam 12 largus imber decidebat.

Barometrum toto hoc tempore ad altitudinem pollicum Parisin. 27. $9\frac{1}{4}$ consistebat. Thermometrum mercuriale (quod in aqua ebulliente notat gr. 0.; in nive vero salis communis duabus quintis partibus permixta, gr. 180) designabat tunc temporis gr. 141.

Monemus interea lumen hocce nedum splendidius, verum & eminentius visum eodem tempore, & ad eandem plagam ab nonnullis *Viterbio* ad Urbem accedentibus, ac ab aliis in Via Valeria (hoc est, ad orientem Romæ) quinto supra vicissimum ab eadem urbe miliario iter facientibus.

Corrigenda in Philos. Transactions, N^o 459.

Page 646. Line 12. for 10° 02' 00" read 10'.

647. Line 7. for Oct. 28. read 27 Oct.

648. Line 9. for 15^h 53' 4" read 15^h 55' +'.

L O N D O N :

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V. The Figure of the Earth, determined from Observations made by Order of the *French King*, at the *Polar Circle*: By *Messrs De Maupertuis, Camus, Clairaut, Le Monnier*, Members of the *Royal Academy of Sciences*; the *Abbé Outhier*, Correspondent of the Academy; and *Mr. Celsus*, Professor of Astronomy at *Upsal*. Translated from the *French* of *M. de Maupertuis*.

VI. De Græcis illustribus Linguae Græcæ Literarumque humaniorum Instauratoribus, eorum Vitis, Scriptis, & Elogiis, Libri duo. E Codd. potissimum MSS. aliisque authenticis ejusdem Ævi Monumentis depromptis *Humphredus Hodius*, S. T. P. haud ita pridem Regius Professor & Archidiaconus *Oxon*. Præmittitur de Vita & Scriptis ipsius *Humphredi* Dissertatio, Auctore *S. Jebb*, M. D.

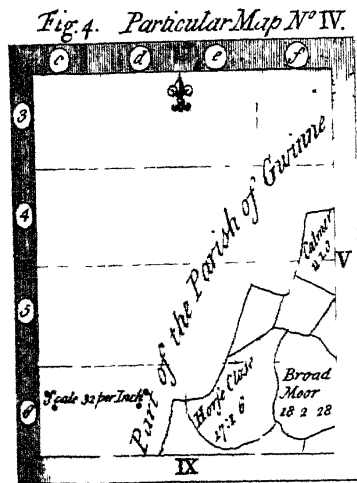
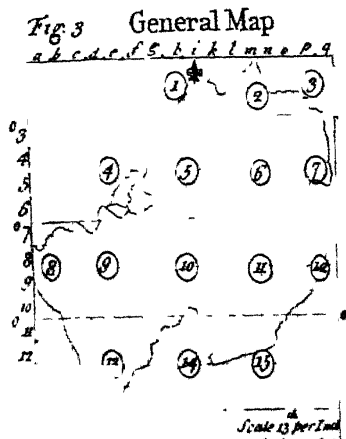
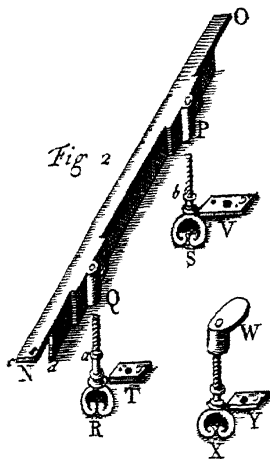
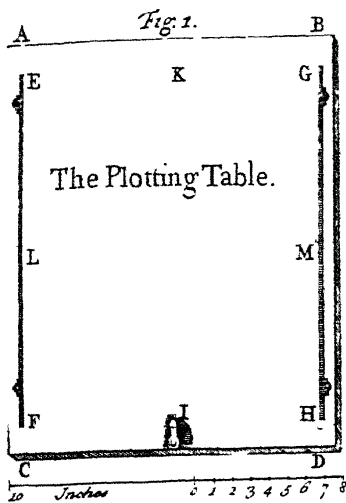


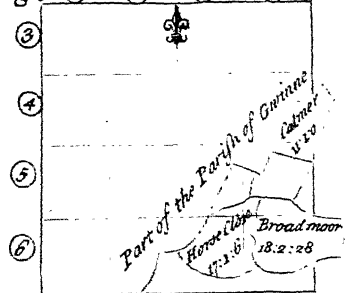
Fig. 6.



5 Inches & 1.

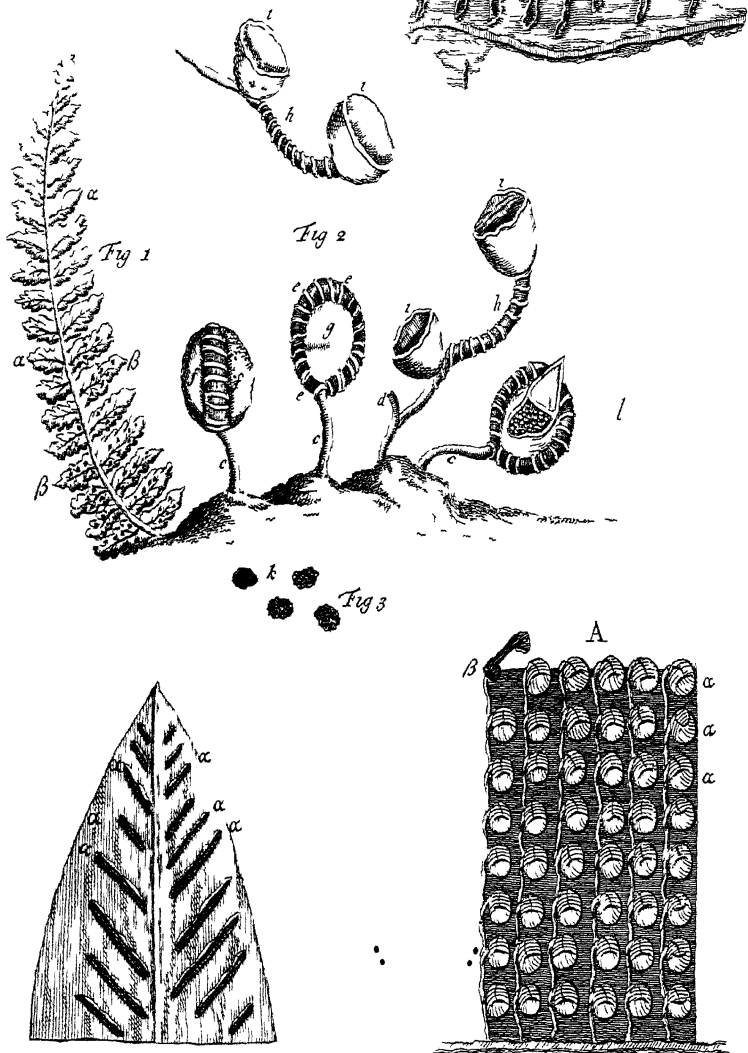
Particular Map N^o IV Varied

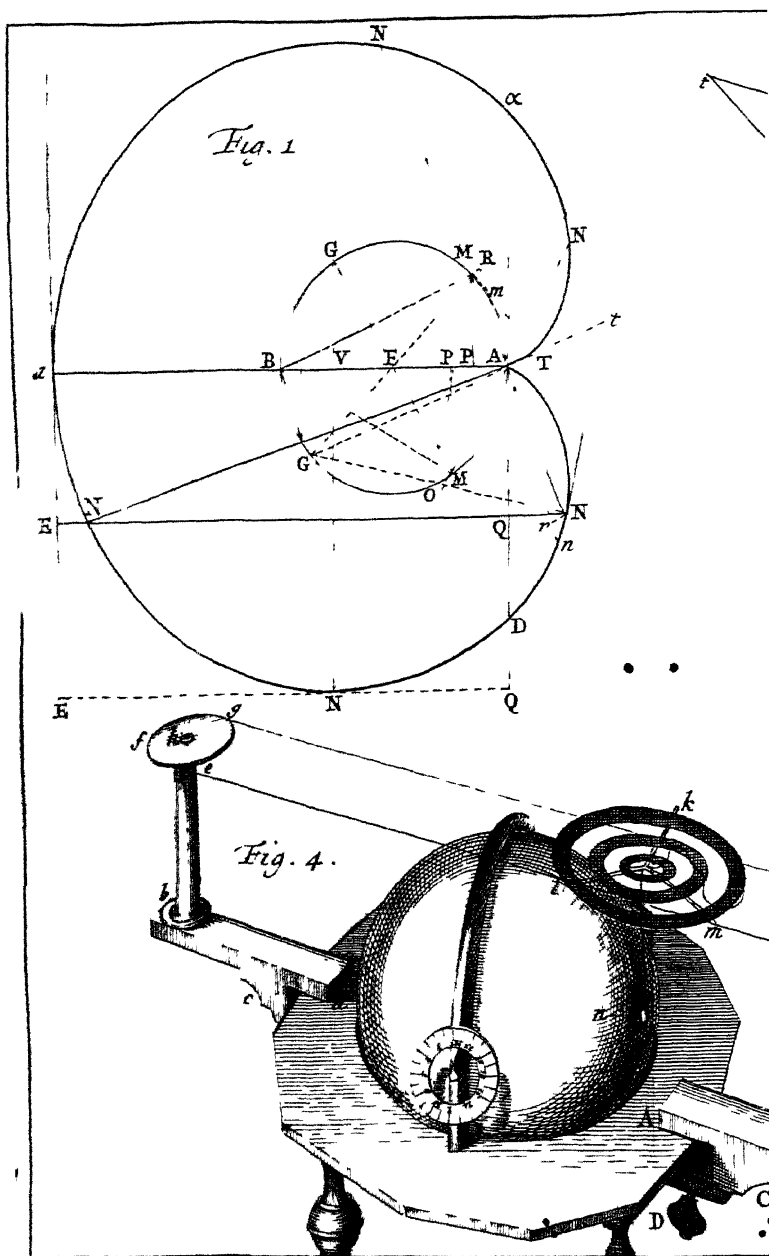
Fig. 5. (c) (d) (e) (f)

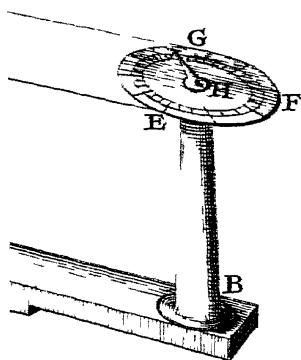
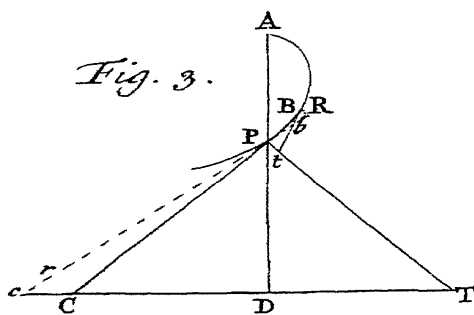
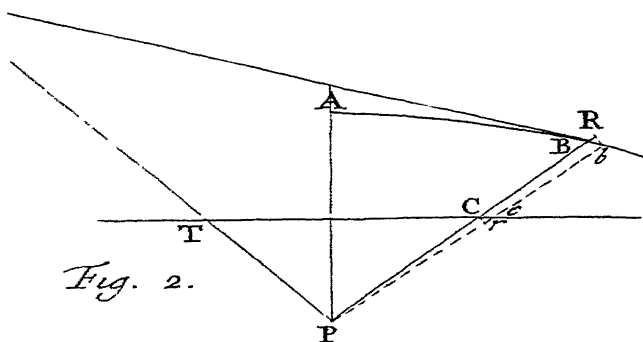


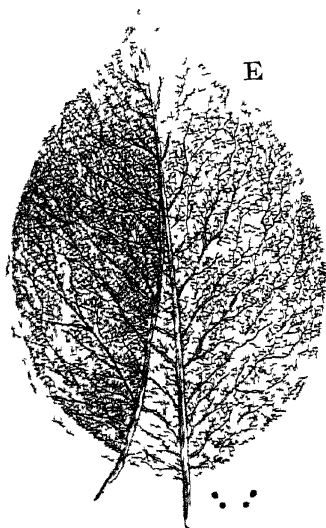
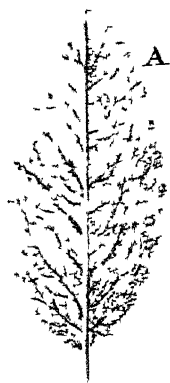
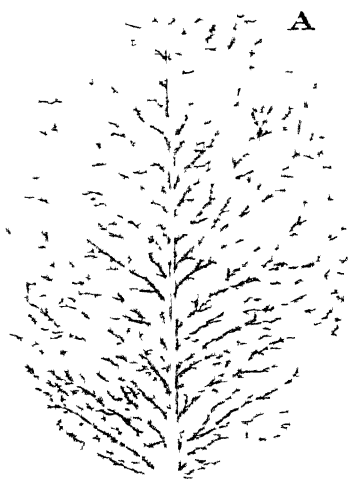
Scale 4 Ch per Inch

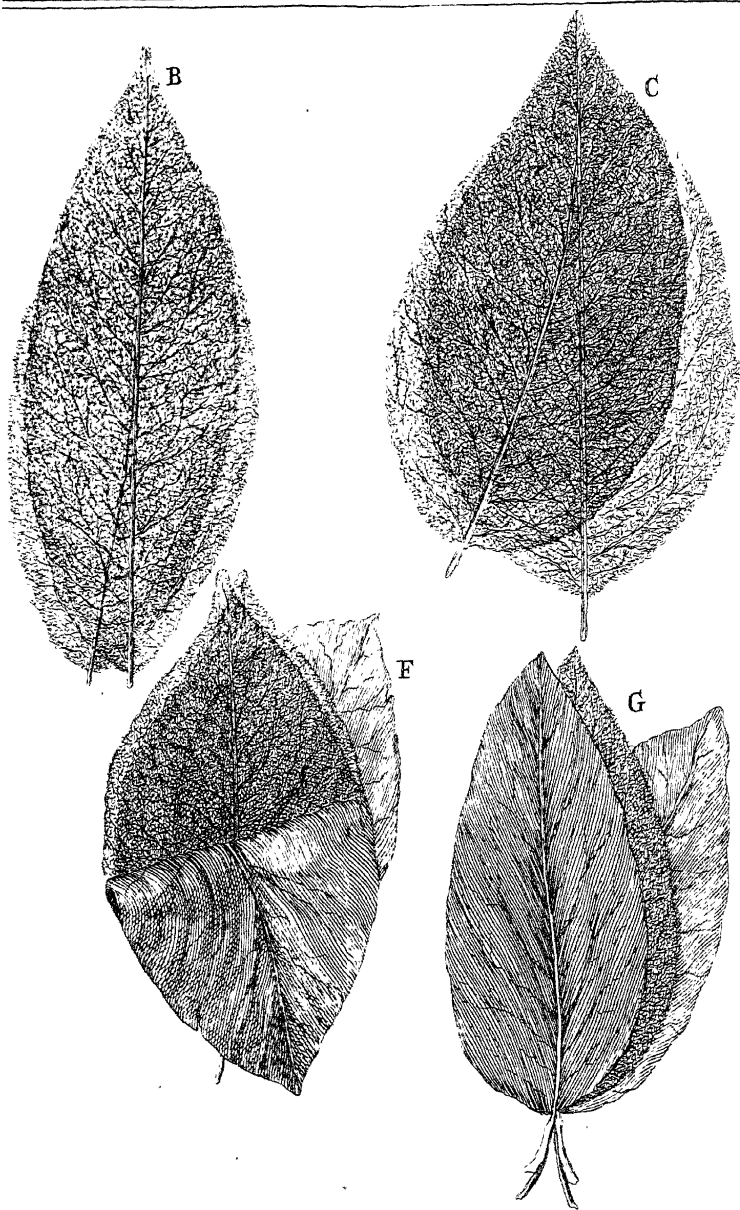
J. Myrde, f.











J. Mynde sc.

Fig. 1.

4
3
2
1
Feet

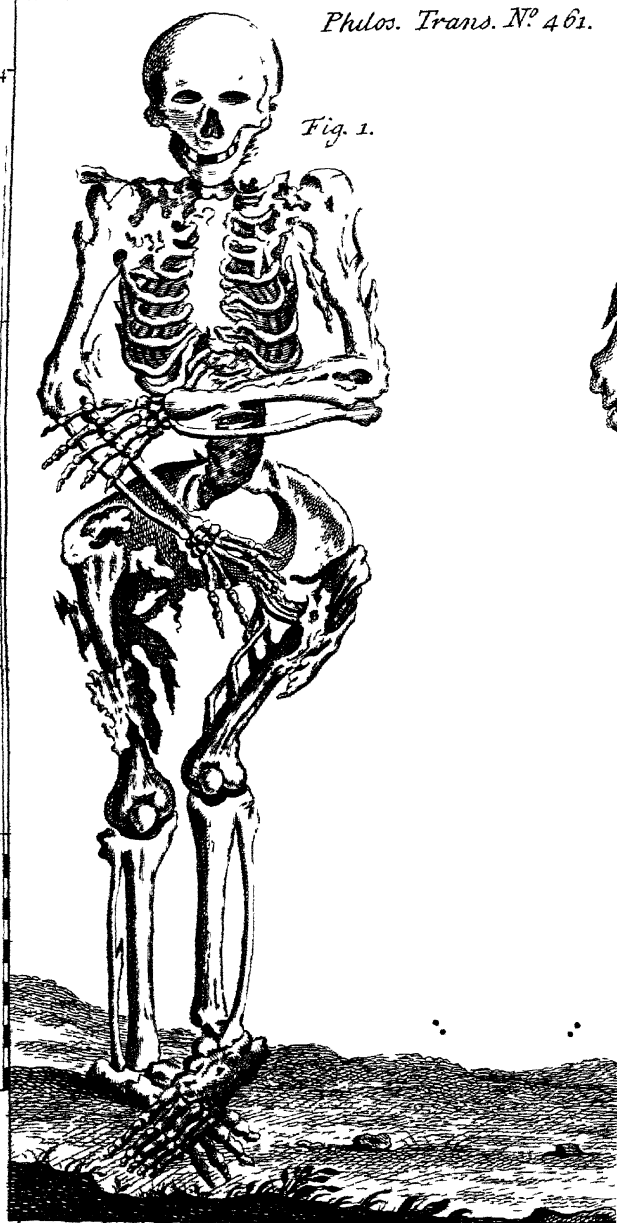


Fig. 2.

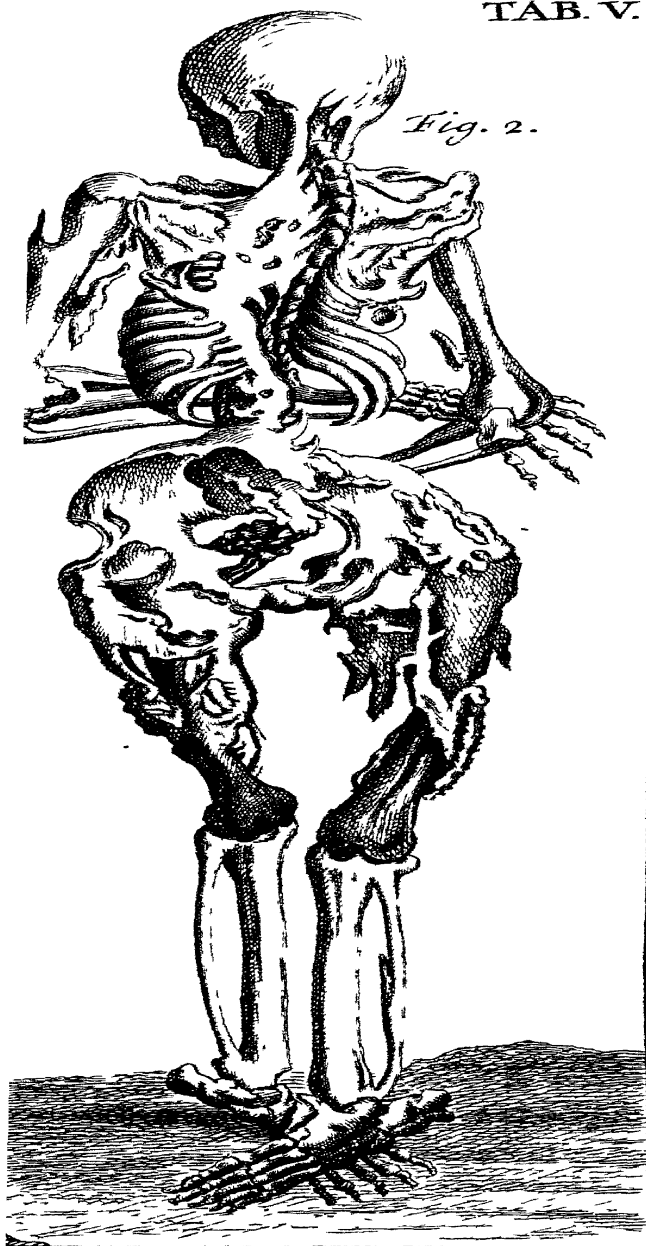
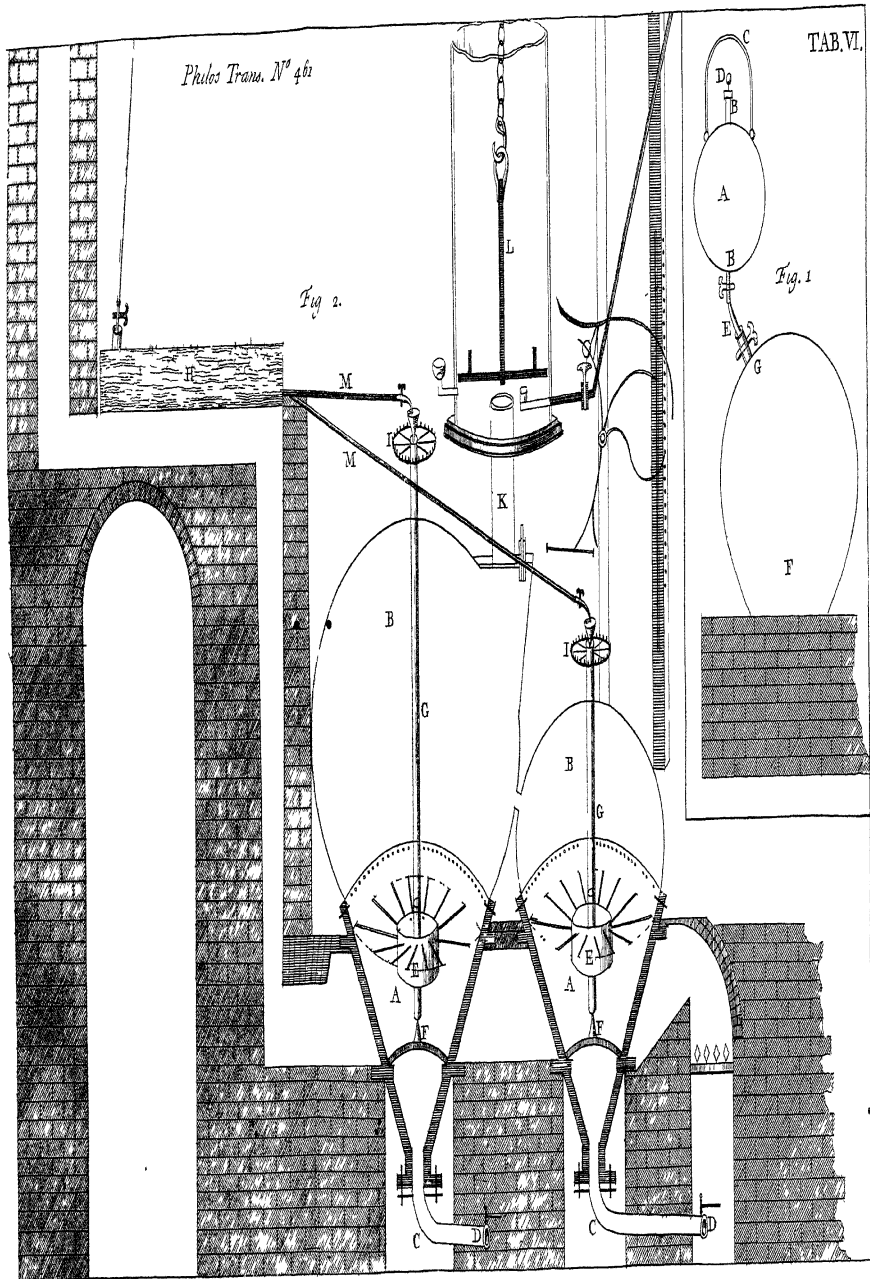
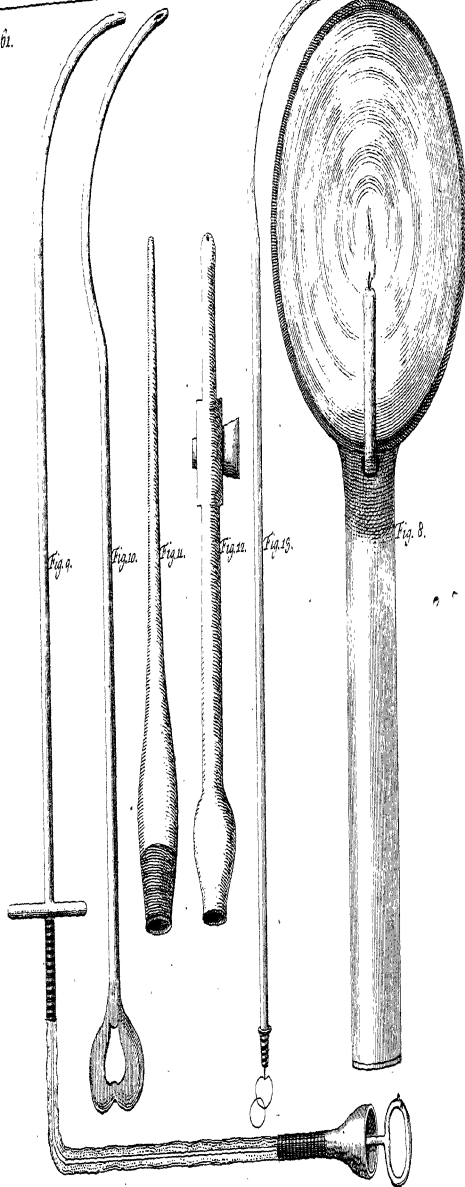
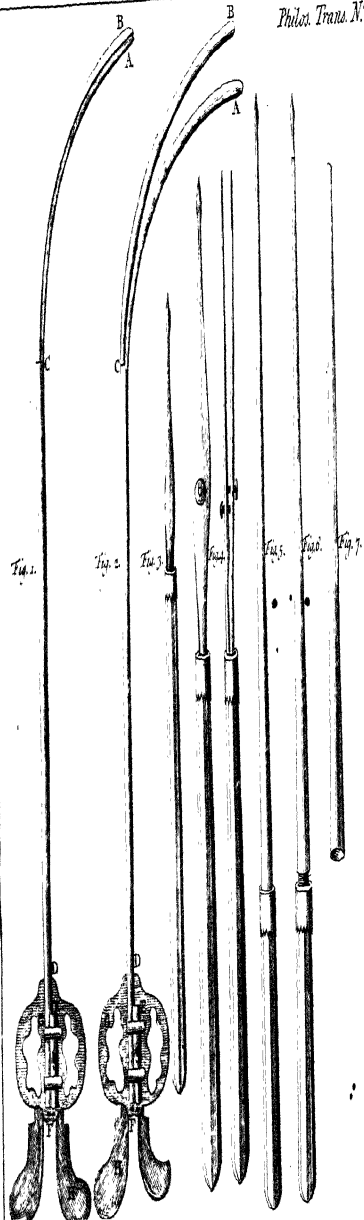
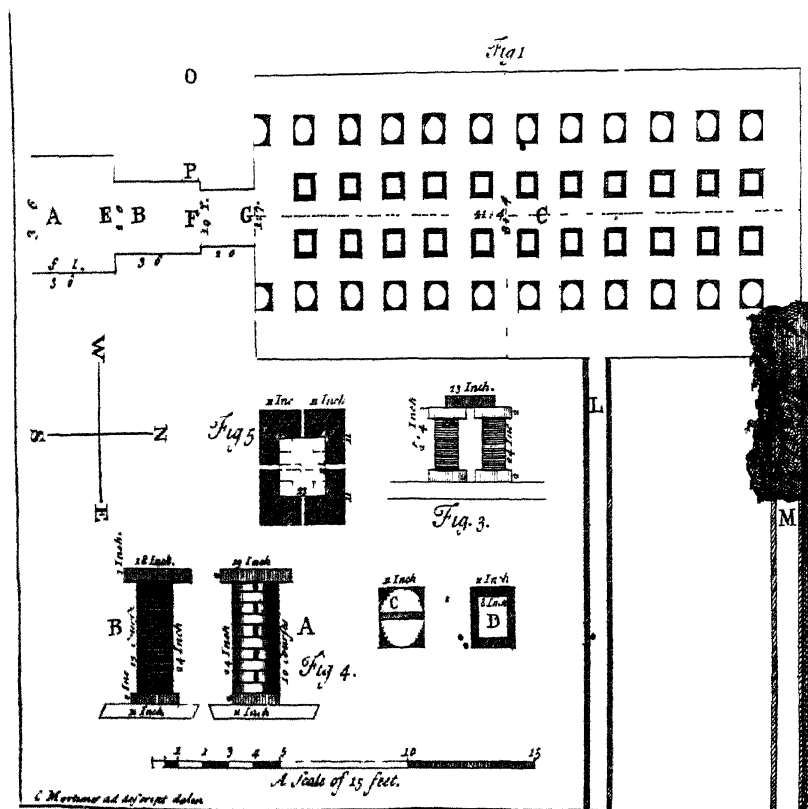
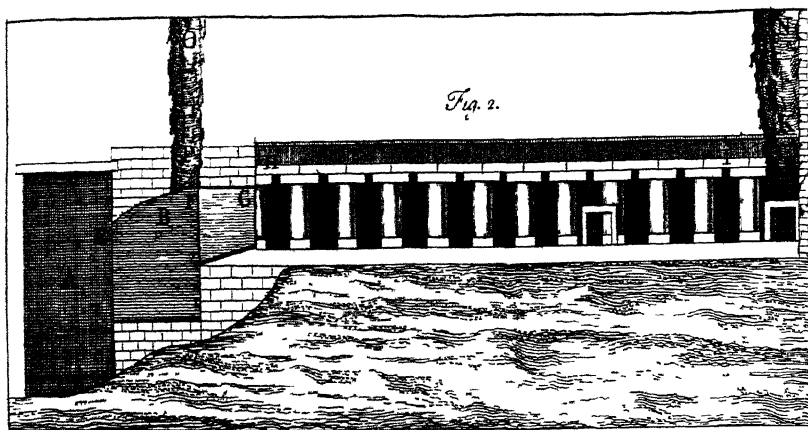


Fig. 2.

Fig. 1.







- A *The Tombex.*
B *The Plank.*
C *The Sheathing.*



Fig. 6.



Fig. 7.

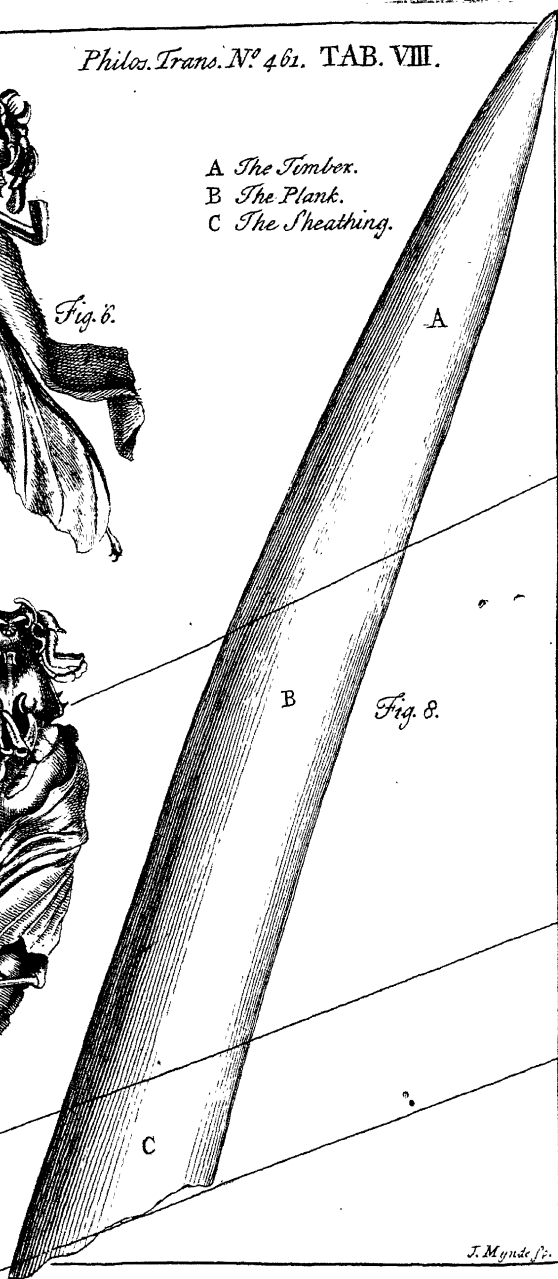


Fig. 8.

I. *A new Plotting-Table for taking Plans and Maps, in Surveying: Invented in the Year 1721. by Henry Beighton, F. R. S. Inscribed to the ROYAL SOCIETY.*

THE principal End and Design of Writing or Publishing, should be to convey down some useful Knowledge to the rest of Mankind, since it is what we are indebted, to communicate our Talents, in return for those Helps we have received from others.

Whoever writes on any of the practical Parts of the Mathematics, his chief End and Aim should be, at one or both of these Two Things, Certainty and Expedition, wherein consists the very Life and Beauty of a Science.

That Time and Observation have produced better Instruments or Improvements, is a Truth not to be denied; but at the same time that there may be new Instruments, and yet worse, is equally true: The eager Thirst after, and Humour for Things new, and in Vogue, have sometimes been the Occasion of rejecting some old Inventions, much superior to the new ones in Practice.

What I have to say on the Subject, and to make good what I have been aiming at, shall be in the practical Part of Surveying, *viz.* The taking of Plans or Maps. And here, perhaps, I may be thought to need an Apology, in seeming to propose a new Instrument, whilst I am blaming others for the same thing. But when I tell you mine is an old Instru-

ment improved; where I have obviated all the Difficulties that hitherto attended it; and made it to answer all the Objections that have been raised against it; and demonstrate that it is subservient to all Parts of the Art, for which such Instruments are designed; I may in some measure seem to be justified.

The Instrument is (what has been hitherto called) the *Plain Table*. One of the chief Objections against it was, the Difficulty in shifting of Papers; for you were almost necessitated, when you were at work on a Sheet in the Table, to put in all the Work that is to be contained thereon, (because it is very impracticable to put it on the Table in the same precise Position again) and this although it were with the utmost Inconveniency, in pursuing some grand Station, on circumscribing the Whole. This is entirely obviated; and I have remedied all the other Objections against it (as may be seen hereafter), in a very simple and easy Manner, which I contrived in the Year 1721. for making a correct Map of the County of *Warwick*; by which, with good Success and Expedition, I completed and published the same in the Year 1728. and call the Instrument *The Plotting-Table*.

Griff, July 14. 1739.

Henry Beighton.

A Description of the Plotting-Table.

IT is a plain smooth Board, about 18 Inches square, and Three-quarters of an Inch thick, as TAB. I. Fig. 1. *ABCD*, made of *Mahogany*, *Walnut*, *Pear-tree*, or *Norway Oak*, well clamped at the Ends,
or

or a brass Frame round it, to prevent its warping, and, as much as possible, shrinking and swelling.

Within Six-tenths of an Inch of Two of its opposite Sides (and parallel to them and one another) are Two Grooves *EF*, *GH*, cut on the Face half an Inch deep, to let in Two brass Holders in the Shape of *NO*, Fig. 2. which are each of one Piece of cast Brass, like Two brass Rulers, joined together at Right Angles. The perpendicular Part is One-tenth and Three hundredth Parts of an Inch thick, as at *d*, half an Inch deep, and a little shorter at each End than the upper Part, which is 17 Inches long, Three-tenths broad, and about Eight Parts of an hundredth of an Inch thick; about Two Inches and an half from each End of the Holder, are thick Parts or Bosses in the upright Piece, as at *P* and *Q*, through which are Holes tapped, to receive the Screws *PS*, *QR*, which Screws go each through a brass Plate as *T* and *V*, fixed by Rivets on the under Side of the Table, and little round Nuts (as at *a* and *b*) put on them, to confine them to their Shoulders in turning in the Plates, that they neither rise nor fall; these Holders must go easy in the Grooves, to sink easy and even with the upper Surface of the Table. Then, when the Screws enter the Holes of the Holders, by turning *R* and *S* at the same time forward, the Holders will fall, and pinch down any Papers, &c. that are under them; and, turning backward, will rise and release them. In the Middle of one End of the Table is a Groove to receive the Brass *W*, which has the same sort of Screw and Fixing as the other, to raise or fall it. But the Groove is quadrantal, that the Holder *W* may on Occasion be turned so as to lie all on the outside the

Line *EH*, and to cross it, in case of high Winds, for securing the Papers down, on Three Sides; and a Fourth might be added, but there is seldom any Occasion for it.

To the Centre of the Table underneath, is fixed a brass Socket, so truly made, that the Table may, when set, turn round truly horizontally: And a Machine, cased with Glass, in which a Plumber hangs, to set the Table level; or the parallel Plates, and glass Tubes of Spirit of Wine, may be used, to set it horizontal, as any one sees Occasion to fancy them.

To any one of the Four Edges underneath, is screwed a Box and Needle, set to the Variation.

There belongs to this Instrument, a strong Three-legged Staff, and an Index with plain or telescopical Sights, near Two Feet long.

The Papers, or Charts, for this Table, are to be either a thin fine Pastboard, fine Paper pasted off Cartridge-paper, or Two Papers pasted together; cut as exactly square as is possible, each Side being nearly 16 Inches and an half long, just as they may slide in easily between the upright Part and under the flat Part of the Holders.

Any one of these Charts will be put in the Table any of the Four ways, be fixed, taken out, and changed at Pleasure: Any Two of them may be joined together true on the Table, if you make each of them meet exact at the Line *LM*, whilst near one half of each will hang over the Sides of the Table; or by creasing and doubling each, the Whole of them will be within the Table. And if Occasion should happen, as seldom it does, by creasing each Paper both Ways through the Middle, Four of them may
be

be put on at one time, meeting in the Centre of the Table.

Each Chart is always crossed by Right Angles through the Middle, for the Purpose above, and to make any of them answer to the Guide-Lines on the Table, Fig. 1. *IK*, *LM*, drawn quite through the Centre, and the whole Table.—So the grand Objection of shifting Papers is obviated.

Its Facility and Dispatch,

As also its Certainty, compared with any of the most celebrated Instruments, I shall now briefly set forth.

But, in order thereto, it may not be improper to premise, or lay down, as *Lemmata*, these Three Things:

1. *The essential Business or Aim in surveying of Lands or Countries, is either to have an exact Plan, or to find the Area in some known Measure.*
2. *Every thing that is superfluous or foreign to such Design, is better omitted than taken.*
3. *If a true Survey, and exact Plan be made, every Part will have its just Proportion, and every Angle its true Opening or Quantity.*

Then what need have we of Degrees, Minutes, &c.? They are never made any Use of in the Practice of casting up, or any thing related thereto: For, if from a Station Two Lines be drawn by a good Index to Two distant Objects, will it not be
the

the very Angle, and identically the same, as if it had been taken by the most celebrated Instrument, in Degrees and Minutes, and laid down by a Protractor?

The first is much more expeditious, easy and certain, than the other. More expeditious, because those Two Lines are sooner drawn than an Angle can be taken, which done, Two-thirds of the Work is behind, *viz.* Writing down and Plotting. More easy, as done with One-fourth of the Trouble. More certain, because one may be liable to Mistakes in taking the Degrees or Minutes; in setting down, and in protracting. And if it should so happen, that one numerical Angle should be taken, set down, or plotted to the wrong Coast, (where they depend on one another) so great an Error would ensue, that could not be retrievable, but by going on the Spot, and performing the Operation anew. Now the Plotting-Table, after Two Stations, proves every thing on the Spot; for, from every Station you are upon, the Index must point at the same time to any Station on your Map, and its corresponding Object in the Field; which is a demonstrative Proof, for nothing but Truth will agree.

In several Branches of the Mathematics, it is absolutely necessary to take Angles in Degrees, Minutes, and their Subdivisions, as Astronomy, Trigonometry, Navigation, Longimetry, inaccessible Heights and Distances, &c. and also in taking large Plans, to calculate and prove Things by Trigonometry; which would not only be a Work of Curiosity, but very commendable. But where the Nature of the Thing will admit of as good Proof, with One-tenth-part of the Trouble and Time; it would be like running the
So-

Solution of an easy Question into a long Process of Algebra or Fluxions, when the plain Rule of Proportion would justly answer the same.

It is objected, That, in surveying by the Plotting-Table, the shrinking or swelling of the Papers, are a great Inconveniency.

In Answer to this, it may be said, The same Inconveniency attends the surveying by any other Instrument, so soon as it is plotted; for both Velumn and Paper will shrink and swell in the House on the Alteration of Weather (as well as all Bodies); for a Line of 48 Chains, plotted by a Scale of 3.2 *per* Inch, in a hazy Morning, in a clear Afternoon the same Day, measured but 47 and an half: And there are various Shrinkings and Swellings, according to the Weather, and Difference of Paper, &c.

In the Plotting-Table this Inconveniency is in a great measure remedied. For in what State soever of the Weather you put Lines on the Chart, the Holders give Marks on the Chart as it then stood; if it was moist and swelled up in the middle Part, you may, when you either cast up or measure Lines, by laying it on a damp Floor, put it in the same Condition as it was when you plotted the Lines. If you plotted in dry hot Weather, and are casting up in damp or moist, a little heating by the Fire will reduce it to the same State again. Another Remedy I have long used is, to plot and measure by Scales of the same Paper, which will shrink or swell in proportion as your Map does.

But it will be well to observe here, that the Shrinking and Swelling alters the Lines only, and not at all the Angles: For, let a Polygon be never so much
uni-

uniformly extended or contracted, each Angle must contain the same Number of Degrees and Minutes as before. Hence this Objection falls no harder on the Table, than on all other Instruments.

And here I intended to have ended this Discourse: But as I have some other small Improvements, not only in the Instrumental Part, but in a new Method of disposing the Maps, and better adapting them to all subservient Uses; I proceed.

I should have said before, that each Chart has a *Flower de Lys* on its North Edge; and, as the Needle is moveable to any Side, Care must be taken, that the North End of the Needle, when it stands, should point the same Way as the *Flower de Lys* on the Charts.

I use a Needle about Five Inches long, placed in an oblong wooden Box, but just so wide as the Needle may play double the Degrees of the Variation West, viz. 30°. In the Middle of one End is the *Flower de Lys*, and the Box is by Studs and Holes always put on the Table oblique to the Quantity of the Magnetical Variation. I make no other Use of the Needle, than to set the Table in the Meridian, and to prevent any great Mistakes, in joining or placing the Charts wrong.

I have no more than half an Inch of the Needle that appears from under the Table, for the Reason it should not be in the Way, or so subject to be damaged: The making the Box so narrow, is to check its playing, that it may sooner hang still over the *Flower de Lys*. The wooden Box, lined with Paper, I find preferable to a large brass Box, and large Glass, which
in

in cold and hazy Weather, condenses the Vapour and Air so much, as to make the Needle very languid and dull.

Farther Uses, by taking a Survey in the new Method by the Plotting-Table.

The Charts, thus taken, are more readily laid together by Numbers on their Edges, which tally, and make up the whole Map in one Plan, or View, and are, in these Squares, more portable.

In the second Place, they are more readily copied, extended, or contracted. For, by having a Frame of Wood that just encompasses a Chart, divided by 19 Threads at equal Distances, and the same at Right Angles, the other Way; each Five or Ten, &c. being distinguished by Silk of a different Colour; a Reet is made of 400 Geometrical Squares, from which, having a Velumn or Paper so divided by lesser or greater Squares; then drawing or copying by Help of the Lines into those new Squares, you have your true Map contracted or extended.

Large Maps of Lordships are not any ways convenient, or portable, to have recourse to on the Spot or Place they represent; being subject to Damages, unfit to be opened in rainy Weather, very troublesome in the Wind, and very difficult to find out the Part you want. To remedy all these Inconveniences, some Years ago I contrived a new Method of disposing them, in such Manner as makes them more sure, safe, ready, convenient, durable, and portable, than any other Method.

And this is done by imitating the Geography of the World, which first gives the Whole, then the several Kingdoms, Countries, Provinces, and minuter Parts and Divisions, severally and more at large.

First, It will be highly necessary, that a *General Map* of the whole Lordship (Country, &c.) be drawn in one Sheet of Paper or Velumn, to give the Form, Idea, and Proportion, that the Parts bear to the Whole, and one another; by which Situations, Bearings of the Towns, Villages, Roads, and remarkable Places, will be seen at one View: And this must be reduced to so small a Scale, as the intended Sheet may comprehend the Whole. A Scale of about 11 or 12 Chains in an Inch, will plot a Lordship of more than 2000 Acres, in the Compass of 16 Inches and One quarter Square; which may be a convenient Size to make Two Leaves, and open in a *Folio Book*. This Map may express the Roads, Rivers, Streets, Boundaries, Inclosures, and common Field Lands singly, in case they be not less than 40 or 50 Links in Breadth: The Pieces that contain not less than about 10 Acres, will admit of Room to write the Owners Names and Quantities in Statute Measure, as in Fig. 4. But for all the small Parts, there will not be room to explain them: Therefore—

I divide the general Map into as many Geometrical Squares, as it took Charts in surveying by the Table, by red Lines, as in Fig. 3. horizontally and perpendicularly, as noted by 0,0,0,0, &c. which, by a Scale of 32 *per* Inch, may take about 15 Charts in Number: In the openest Place near the Middle of each Square, in a small Circle, I number them with red Figures 1, 2, 3, &c. corresponding to the original Charts:

Charts: And in the Middle of each of their Sides, Numerical Letters, shewing how the particular Maps are to join to each other.

The particular Maps are each as large as the general, and numbered at the Top I. II. III. &c. corresponding to the Squares in General, as Fig. 4. where, in the Right Hand Margin, is put V. and at the Bottom IX. shewing the Fifth Map tallies to the Side, and the Ninth to the Bottom, or South Part: The general Map being an Index, shewing how they join to each other.

By these particular Maps may be shewn all the lesser Quantities, with their Tenure, Owners Names, and Contents; and, by the Scale, are capable of shewing the Lengths of any Lines, and the Dimensions, so as to discover any Encroachments, and record their Shape and Extents to Posterity: A most valuable Use of a Survey and Map.

All these Maps are bound up in Order, in a Folio Book, to open freely, which will be not only very portable, but useful to have recourse to on any Occasion; secure from Damages of Weather, as well as more durable and ornamental.

The Terriers to these Maps are made in the following Manner; either bound in a Book of a Pocket Size by themselves, or along with the Maps.

The Names of the Frecholders, Copyholders, Cotagers, Tenants, &c. are put in an Alphabetical Order.

Refer. to the Map.	The Names of the Lands, their Situations and Boun- daries.	Tenure	Free- hold			Copy- hold		
			<i>a</i>	<i>r</i>	<i>p</i>			
IV. f. 4	<i>Calmer-Close</i> in the Village of <i>B.</i> —the Parish of <i>Gu.</i>	Freehold	11	1	—	—	—	—
	<i>W. Townsend</i> E. Own S.							
IV. f. 6.	The House and Home stead called <i>Broadmoor</i>	Copyhold	—	—	—	18	2	28
	<i>Horse Close</i> W. Own E. N. S.							
IV. e. 6.	<i>Horse Close</i> <i>Guinne</i> W.	Freehold	17	1	6	—	—	—
	<i>Broadmoor</i> E. <i>Pitts</i> N. S.							

In this like Manner, under every different Name, may all the Parcels be expressed separately.

To find any Piece or Parcel of Land in the Lordship readily, first find the Tenant's or Owner's Name in the Alphabetical Order, under which, in the Second Column, may the Parcel be found. The Third shews whether it is Free or Copyhold; the Fourth or Fifth, the Quantity in Statute Measure, either Free or Copyhold.

The numerical Letter in the Margin on the Left IV. shews it is in the Fourth particular Map; f. 6. refers to the Parts of the Map; find f. at the Top, and 6 on the Left Side, and in the Angle of meeting of those Squares is the House, Close; and so for any other.

There is but one Objection I can at present foresee, that can bear any Weight against this Method of dividing the general Map, *viz.*

That by dividing the same into geometrical Squares, many of the Parcels, Lands and Grounds, will be cut into Two separate Pieces; one Part whereof will lie in one particular Map, and the rest in

in another; as in Fig. 4. Map IV. Part of *Calmer* and *Broad-Close* will be in the Vth Map.

In this Case, it is usual to put the Owner's Name, and Quantity, in that which is the greater Part, and in the Terrier refer also to the Remainder; where, if the Shape, Lengths, &c. are required, they may be discovered.

But as this may not be satisfactory, or fully answer the Objection; the Two following Methods will intirely obviate the Difficulty, and make them as fully subservient to all Purposes, as any large and intire Map on one Piece.

1. The first Method is, to take just so much in a particular Map as is circumscribed by some known Roads, Lanes, Brooks, Boundaries of particular Owners or Tenants Lands: This, indeed, will often make the Map very disproportional, and irregularly shaped; but cannot be a material Objection, by reason, in Surveys, there is seldom any thing regularly shaped.

2. The second Method is, to have a wider Margin, or rather draw the particular Maps by a smaller Scale, as Four Chains in an Inch, instead of Three Chains 20 Lines; and that will allow Room to add the Parts of the Parcels so cut off in the Margin, as in Fig. 5. the IVth particular Map varied, where the Whole of *Broadmoor* and *Calmer* is drawn; then in the Vth and IXth particular Map, may the small Parts, which are in the IVth, be drawn in full: Then will they join by indenting or tallying one into another.

To reduce a Scale to fit exactly your general Map.

First see what Extent the whole Survey takes on the Charts you laid it down by in the Field, *viz.* the greatest Depth and Breadth, as from the Specimen of the general Map it may appear.

Depth		Breadth	
On the upper Chart is	N ^o 2 = 10 Inches.	N ^o 8 = 5 Inches	
	N ^o 6. 16 $\frac{1}{4}$ $\frac{1}{2}$	N ^o 9 16 $\frac{1}{4}$ $\frac{1}{2}$	
	N ^o 11. 16 $\frac{1}{4}$ $\frac{1}{2}$	10. 16 $\frac{1}{4}$ $\frac{1}{2}$	
	N ^o 13 10 $\frac{1}{2}$	11. 16 $\frac{1}{4}$ $\frac{1}{2}$	
		6 $\frac{1}{2}$	
The Whole	53 $\frac{1}{4}$	The Whole	60 $\frac{1}{2}$ $\frac{1}{2}$ qr.

Then having fixed on the Size of the general Map to be 16,37 Square, I form a Scale of 60 $\frac{1}{2}$ *per* Inch, that may just extend the whole Breadth of the ~~16,37~~ Inches; by which you may form all the Squares, and Parts of Squares, in Depth and Length, as above; and at Fig. 3. is divided,

The Breadth of the whole Map, by a Scale of 32, is 60,62 Inches, which I would reduce into the Compasses of 16 $\frac{1}{4}$ and $\frac{1}{2}$ = 16,37 Inches.

Divide 60,62 by 16,37, gives 3.7, which multiplied by 3,20, makes the Product 11,84, that is 11 Chains 84 Links in an Inch, the Scale for the general Map.

Thus have I done all I intended; but shall observe, that several of these Tables have been made, and, as People have fancied, with Alterations and Additions; but all Variations are not really Improvements. The setting it horizontally by Spirit— Tubes, may be curious enough: But as the Difference is very inconsiderable and indiscernible, when it stands Two
or

or Three Degrees out of the Level, I shall not trouble myself or others about it; only further observe, that when Grounds are declining much, and very uneven, if the Table stands horizontal, unless the Sight or Mark on the lower Part is so high as its Top makes a Level with the upper Part of the Table, which is seldom done, or practicable, I do not see why such a Stress should be laid on the Instrument's being level, when neither the View by the Index, nor the Measure of the Line, either can be, or is taken horizontally: If the Sight of the Index stand nearly perpendicular at every Observation, it is more than sufficient for any Exactness requisite in a Survey.

II. *A Letter from Richard Richardson, M. D. and F.R.S. to Sir Hans Sloane, Pr. R. S. &c. inclosing a Paper from William Wright, Surgeon, concerning a large Piece of the Thigh-bone, which was taken out, and its Place supplied by a Callus.*

SIR,

I Take this Opportunity of inquiring after your Health by my Son, who waits upon you with the inclosed, and Part of the *Os Femoris* accompanying it [see TAB. I. Fig. 6.]. As the Case appeared to me something remarkable, I thought proper to communicate it to you. It was drawn up by Mr. *Wright*, a Surgeon, in *Bradford*, in the West-Riding of this County, who performed the Cure; and a few Days ago,

ago, for my Satisfaction, brought the Person hither, who that Day had walked Nine Miles before Noon. I examined the Part where the Bone was taken out, which is on the Inside of the Thigh, about Four Inches above the Knee; and found the Thigh quite strait, but rather thicker than the other, where the *Callus* supplies the Defect of the Bone taken out. He appears to be very well and healthy, and makes no Complaint of any Weakness, or Uneasiness, in the Part; neither is he in the least lame. He brought the Bone, which I herewith send, some time ago, and, at my Request, drew up the Case: You may make what Use of it you please: I really believe the Contents to be true; and shall be glad of all Opportunities of obliging you: If any thing farther occurs to me worth your Notice, you may be sure I shall give you an Account of it. I find a Case of this kind in *Ruyseh's Museum Anatomicum*, Pag. 172. but he gives no Account of the Cure; neither is it so extraordinary in itself, as it is only Part of the *Os Tibiæ* which is separated; and this which I send you, appears to me to be the whole Substance of the Bone, except what was eat away before it was taken out.

Your very humble Servant,

Bierley, Jan. 16. 1739-40.

Richard Richardson.

S I R,

THIS Bone is Part of the *Os Femoris*, taken out of a young Man's Thigh, viz. 20 Years old, about the latter End of *March* 1738. His Name is *Hird Ramsden*, he lives at a Place called *Braithwait*, near *Kighley*. His Lameness was occasioned by a Fever,

Fever, which was translated into his Thigh, where it impostumated, and was afterwards opened; but, not healing again, left Three or Four carious or fistulous Ulcers, which discharged a great Quantity of *Sanies*, and fetid Matter. In this Condition he had been Six or Seven Years, before I was concerned for him, and was looked on as incurable; this continual Discharge had reduced him almost to a Skeleton. I examined his Ulcers with my Probe, and found in one of them, which was on the Inside of his Thigh, a rotten Bone: I dilated the Orifice with *Gentian* and Sponge Tents, and afterwards I laid it open about Three or Four Inches: I then dressed it with *Tincture* of *Myrrh*, and Dossils of dry Lint; and at every Dressing, over the carious Bone the Powder of *Rad. Aristot. Myrrh*, and *Euphorb.* in order to promote Exfoliation: With these Applications the Bone began to loosen, which looked much larger than I expected. I was afraid of making another Incision because of the Crural Artery, which lay very near the Place where the Bone was taken out: I therefore chose rather to do it gradually by dilating the Orifice, than run the Risque of another Incision. The same Dressing was continued, and the spongy Flesh kept down with the Powder of *Mercur. præcipit. rub. & Alum. Ust. aa.* At every Dressing I raised the Bone with a hooked Instrument, and in about Four Months time I got it quite out. The Cavity was afterwards kept open for some time, with Dossils of dry Lint, to make way for some loose Pieces that were left behind. The Ulcer, after it was well digested, healed up in a little time. During this time his Knee was very much contracted, which was afterwards extended

by the Use of emollient Fomentations. He now is perfectly sound, and in a good State of Health, walks strait, and his Thigh is not any shorter than the other. This is the true State of the Case. I am,

S I R,

Bradford, Jan. 15. 1739.

Your humble Servant,

William Wright.

III. *An Account of a monstrous Foetus, resembling a hooded Monkey: Communicated by Mr. William Gregory of Rochester.*

A Woman, aged 44, of an athletic Body, conceived with Child a little before *Christmas* 1730. upon which ensued all the usual Symptoms of Pregnancy. Soon after Conception, some Fellows who travel the Country, with a *Bear* and a *Monkey*, placed themselves before the Woman's Door, in order to make Diversion for the Populace. The *Monkey* had a Hood on, which reached to his Shoulders, of which the Woman took prodigious Notice; and all the time the *Monkey* was playing his Tricks, in turning over a Stick, &c. the Woman could not keep her Eyes off from him. Some small time after, the Woman met a Man of a thin, pale, dismal Aspect, upon whom she looked very earnestly, and thought his Face to be (to a Tittle) like the *Monkey's* Face. When the Woman was quick with Child, and the *Foetus* began to move, the Woman felt it turn over
and

and over, many times successively, just as the *Monkey* turned over the Stick; and as often as it moved, it was in the same Manner. In the Seventh Month of her Pregnancy, she was taken ill, with a Vomiting, Gripes, and Looseness, which soon ceased without the Help of Medicine; upon which the Woman's Belly began to grow less, and the *Fœtus* did not move so often, nor so strong, as before. The Woman began to be very uneasy, thought her Case dangerous, and that she was not with Child; upon which she consulted me. I examined how she was from the Beginning, and found her Case as above related: I then gave it as my Opinion, that she was with Child, and begged she would not take any Medicine, until her Time of Reckoning was expired, which (with much Difficulty) I prevailed upon her to consent to. ~~She~~ ^I was sent for in a Month after, and was desired to give her something to bring down her great Belly, she believing herself not with Child. I was still of Opinion she was with Child, and told her, that what she felt move in her Belly, was in all Probability a Child; and the Fulness of her Breasts, and other Symptoms, were strong Proofs of her being with Child. I endeavoured to convince her, that there was no Danger in her Case, as far as I could apprehend; she being then in tolerable good Health, and able to attend the Affairs of her Family. I again prevailed upon her to desist from taking Medicine for a Month longer: The Month elapsed, and no great Alteration. She felt something move faintly about the Expiration of the Ninth Month, when I visited her, and was then in tolerable good Health, though very uneasy at her great Belly: I told her, that she might be mistaken in

her Reckoning, and that she would go a Month longer: She was positive she was not mistaken, for that she had missed her *Menstrua* some time before *Christmas*, which she never used to miss, but when with Child; and now she could not believe herself with Child, by reason her full Time of Pregnancy was expired. I told her the Danger of taking purging Medicines, whilst she was with Child; and gave her Instances in the Neighbourhood, of the fatal Consequences of some Mens Practice in the like Case; by which I again prevailed upon her to tarry another Month, at the Expiration of which I gave my Patient a Visit, and found her much as she was when I saw her before. Now Ten *Lunar* Months were elapsed, and my Patient felt nothing move in her Belly for Six Weeks past: I then confessed I had mistook her Case, but gave her Hopes there ~~was still~~ a Probability of removing her Distemper, and restoring her to Health; in order to which I immediately sent her an Infusion of *Sena*, *Rhubarb*, *Sal. Tartar.* &c. *cum Syr. de Rhamno*, which she did not take for Two Days after, being the 5th of *September* 1731. My Patient took the Potion about Five in the Morning, and before Six she was taken with the most exquisite Travail-pains: A Messenger was dispatched for me, but, before I could come to her Assistance, she was delivered; the *Fætus* came, with the *Placenta*, *Membranes*, and Humours, all whole, which were preserved until I came, which was soon after; and, to my great Surprise, found the *Fætus* as before-mentioned. I took out my Incision-knife, and divided the *Membranes*; so took out the *Fætus*, with the Twist in the Navel-string, as it now appears; the

Mem-

Membranes were very strong, but the Humours were very foul, and but small in Quantity, though not fetid. My Patient, who is a Woman of Probity and good Understanding, declared, from strong Reasons, that she conceived at the Time above-mentioned, and was delivered as mentioned before; the Twists in the Navel-string are Demonstration, that the *Fætus* moved in the *Matrix*, in the manner my Patient described. The Oddness of the Case made me more particular in giving a true History of it, which, I hope, will be an Excuse for my Prolixity. I need not here mention the exact Resemblance of the *Fætus* to a hooded *Monkey*: The *Fætus* itself will shew it more particularly than I can relate it.

I aver the above Case to be strictly true, to the best of my Knowledge, as witness my Hand this 30th Day of *April* 1733.

From Rochester.

William Gregory.

IV. *The Case of Mary Howell, who had a Needle run into her Arm, and came out at her Breast.*

MARY Howell, late of *Osvaldestry* in *Shropshire*, Spinster, had on the 3d Day of *March* 1732. a small Needle, which she had stuck upon the Sleeve of her Gown, by her accidentally running against a Door, drove, with some Thread twisted about it, into her Left Arm, about Six Inches below her Shoulder; and a young Woman, (one *Mary Price*)

endeavouring to draw out the said Needle, broke off the Eye thereof, and left the Needle in her Arm: Upon which she directly applied to Mr. *Tomkins*, a Surgeon, in the same Town, who endeavoured to extract it, but could not, without laying her Arm open, which she would not suffer. About a Month after which she felt a gnawing Pain above the Place where the Needle ran in, and up to her Left Shoulder, which lasted her Three or Four Days, and so returned by Fits, till at length (about 17 Weeks ago) she felt a gnawing Pain (she thought) at her Stomach, which made her very sick, and reaching to Vomit, and continued to afflict her (especially in the Mornings) till about the *Sunday* after *Easter* last; in the Evening of which Day she fancied a Pin was got into her Right Breast, in the under Part; and Two Days after applied to Mr. *Robert Nanney*, ~~Surgeon~~, in *Fetter-lane*, who the same Day lanced her said Breast, and extracted the same Needle, as she verily believes, as having no Eye, but the Thread still twisted round it.—Which Needle, about an Inch long, without an Eye, and with Thread still twisted about it, she produced before several; and she saith, that from the Time of the said Needle being so drawn forth, she never had any Return of Pain in her Breast, Stomach, Shoulder, or Arm.

London, June 2. 1739.

V. *Mr. Alexander Orme's pectoral Syrup, sent in a Letter to Sir Hans Sloane, Bart. &c. from Culcutte, dated Jan. 25. 1733.*

℞ Nantsjera Patsja *Horti* Malabarici *cum toto*
q. v. Incis. & contus. coq. ex aquæ font. q. s.
Colaturæ fortiter express. adde Sacchari par
pondus, & coque ad Syrupi consistentiam absque
clarificatione.

Some Uses of the pectoral Syrup.

A Drop or two, with a little Honey, given to new-born Infants, greatly helps the necessary cleansing of the Bowels. Three or Four Drops are a safe Puke for them; and cleanse the Stomach and Bowels from that Phlegm that causes their Gripes.

It is of great Service in most Asthma's, and has relieved, when the best Remedies have failed. If the Fit is violent, give a large Spoonful of it, which will soon procure a Vomit or two. If the Fit is moderate, Two Tea Spoonfuls three times a Day will be sufficient.

In Fevers that are attended with a laborious Breathing, it has been found serviceable.

It is excellent in the Small-pox, as well to vomit in the Beginning, as to help on the necessary Salivation in the confluent Sort.

It helps Coughs, and promotes Expectoration.

From these few Hints, a Physician will be able to adjust its Use in other Distempers. I should not

recommend it, had not repeated Experience convinced me of its Usefulness: And that it may be of Use to Posterity, I mean to Physicians that are really such, I give the Receipt of it to be given to the President and Censors of the College of Physicians, *London*.

VI. *A Letter from the Rev^d Mr. Henry Miles to Mr. John Eames, F. R. S. concerning the Seed of Fern.*

S I R,

IN the Edition which the celebrated *Boerhaave* and *Gaubius* have given us of *Swammerdam's Biblia Naturæ, sive Historia Insectorum*, ~~in~~ *Dutch* and *Latin*, 2 Vol. in Fol. printed at *Leyden* 1737. and 1738. we have an Epistolary Dissertation on the Seed of the Male *Fern*, together with a very curious Cut, representing the Seed-vessels, their Mechanism, and the Seed, as viewed by a good Microscope; inserted at the End of the said History. The Cut I have attempted, with my unskilful Hand, to draw, as well as I could; and, possibly, it may help you to conceive of the Form of what it is designed to represent, in some measure.

The Author, I find, claims to himself the having first discovered the Seed of *Fern*, in his Dissertation, at the Beginning: "You rightly judge" (says he to his Friend) "me to have been the first," &c. *Boerhaave* says,

says, that he shewed them to the Botanic Professor at *Leyden Anno* 1673. and that he had drawn the Figures of them. But I find Dr. *William Cole* sent an Account of the Seeds of divers of the Plants called *Dorsiferous*, to * Dr. *Robert Hook*, in a Letter dated *September* 30. 1669. and gives a pretty just Description of the Seed-vessels, and the manner in which they grow, and intended a Delineation of the Figures. *Swammerdam's* great Piety, which shines conspicuously throughout his Work, teaches me in Charity to conclude, he spake what he thought to be true; and, possibly, he might have made the Discovery many Years before the time when he shewed the Seeds to the Professor. However, I am humbly confident of this, (after numberless Trials made with all kinds of Microscopes, and in all Positions, and with different Lights) that *Swammerdam's* Account is just and accurate, in every Point. I have viewed the several kinds of *Fern*, *English Maidenhair*, other sorts of *Maidenhair*, *Wall-rue*, *Harts-tongue*, and find the Seed-vessels of the same Form in all, some little Difference being between some of them in the Size only; and in the manner of their being inserted on the Back of the Leaf, with the Numbers in various Plants, there is a more considerable Difference. I observe, where you have fewer Seeds, you have more of a sort of *Fungus*, or Tubercule, very like what is called *Jews-ears*, which seems to me designed to shelter the Seed, which grow, as under Covert, round about them.—In the Female *Fern*, and *English*

* Who was the first *Englishman* that discovered the Seed of the *Fern* by the Help of a Microscope.

Maidenhair, the whole Surface of the Leaf on the Inside seems covered, so the Seeds guard one another in some measure, though in these I find, after the Seed vessels are shook off, small Membranes here-and-there on the Surface, a little curled, looking as if they had been raised with the Edge of a sharp Penknife, from the Skin of the Leaf, not altogether unlike the Pieces of Skin we are wont to raise in trying a Penknife on one's Hand.

The Plant which I have attempted a Figure of at *B*, TAB. II. with its Seed-vessels, &c. is the *Filix mas Dodonæi*; on the Inside of the Leaves of which are usually seen several Spots placed in a regular manner, of a Light-brown or Russet.—In this Plant the principal Part of these Spots is the *Fungus* before-mentioned, around which the Seed-vessels are inserted.

The Seed-vessels consist of a Stalk, by which they are inserted into the Leaf, as *c c*, of a springy ribbed Chord *ee*, having a great Number of annular Ribs, exactly resembling the annular Cartilages in the *Aspera Arteria*; and I know nothing in Nature so aptly resembling this Chord, as the *Aspera Arteria* of a small Bird, as a *Robin* or *Nightingale*, &c. This Chord incircles the globular membranaceous Pod, wherein the Seed lies, adhering to it, and dividing it into Two Hemispheres. The Pod *ff* is, in Appearance, composed of a fine whitish Membrane, somewhat like that which lines the Inside of a Pea-shell. The Seeds, *Fig. 3. k*, are irregular in Shape, and in the Surface of them, a little resembling a sort of Net-work, which I have endeavoured, in my rude Manner, to mimic.

In viewing this admirable Production of Divine Wisdom in this Plant, I use a single *Lens*, and no deep Magnifier, that I may have the Advantage of the Light falling on the Objects. I throw a Quantity of Seed-vessels on a circular Plate of Ivory; and, if the Plant be newly gathered, (the proper Time is about the Beginning of *September*) I often have the Pleasure of seeing the Seed-vessels burst; the Motion of which at that time may be seen by a good Eye unassisted. But, when I happened to light of a Pod not thoroughly crisp, I have had the Satisfaction of seeing the gradual Procedure of the Bursting of the Vessel, in order to the scattering the Seed, in the following Manner: First, the Chord breaks, and by expanding rends the *Folliculum* or Pod in Two Parts: By going on to expand itself, as it departs from a Curve, and approaches to a Right Line, it rends itself away from the globular Pod *gradatim*, till it be wholly discharged from it; when, as there can be no further Resistance made to the Chord in expanding itself, it naturally gives a sudden Jerk (which in this Case is very gentle); and thereby the Seeds are shed on the Surface of the Plate, in the same manner as if you were to cast some Grains of Corn out of a Bowl on the Plane of a Table-board: This I have several times seen with unspeakable Pleasure; but where the Vessel is more crisp, the Motion of it in bursting wholly escapes the Sight, flying away with great Violence beyond the Field which the *Lens* takes in. Sometimes I have observed the Pod to be 10, sometimes 20 Minutes in bursting; in which time you may have a distinct View of the Procedure. I would add, that I have more than once seen the Pod broke in the Side by some Accident, as at *L*; and

the Seed lodged within, while the Chord has been whole, and still embraced it.

One might have the Opportunity of seeing this curious Piece of Divine Mechanism to greater Advantage, if I could find a way to get the Seed-vessels from the Leaves in a less rude manner than by rubbing them; for they will not easily be discharged from the Leaves, (for I believe they continue a Month after the Seeds are dispersed) so as to collect any Number of them together, and this Method bursts them. When I have been attempting this, they fly about like exceeding fine Vapour or Smoke, and are very troublesome to one's Hands, &c. by getting into the Pores like *Cowidge*.

In the Paper marked *A*, is a Representation of a small Piece of the Leaf of *Harts-tongue* magnified, taken from Dr. *Grew's* Anatomy, or History of Plants, Plate 72. referred to Book IV. Page 200. I was surprised to see that Cut so little resembling the true Figure: Indeed the Doctor says it was a cloudy Day when he viewed the Object; and I am sure he had no just Notion at all of the Spring which embraces the Pod, as to its Texture; for it is by no means spiral, or like a Screw [I have sent you a little Bit in a Paper, to be submitted to your Examination]; nor do the Seeds grow in that regular Manner, as represented in the Figure.

Whatever Use may otherwise be made of this Discovery, a moral one naturally presents itself to us; *viz.* To admire the infinite Wisdom and Skill of the Wonderful CREATOR: For what thinking Mind can help being struck with Astonishment, when he considers the *Seed-vessels* of a coarse Plant, so minute

as to fly about in the Air like Vapour, but a little Remove from being invisible to a naked Eye, framed with such curious Mechanism, containing a great Number of Seeds, too fine to be kenn'd by the acutest Sight without the help of Glasses!

Your most humble Servant,

Tooting, Oct 29. 1741

H. Miles.

References to TAB. II.

Fig. 1. A Branch of the Plant.

Fig. 2. The Seed-vessels.

Fig. 3. The Seeds.

α α. *A Branch of the Male Fern.*

β β. *Refer to the Leaves, on the Back-side whereof, the Excrescencies, like Jews-ears, grow, around which grow the Seed vessels.*

γ γ. *The Stalks of the Seed-vessels.*

d. *A Shoot from the Stalk, producing sometimes another Seed-vessel on the same Stalk.*

ε ε. *The springy Chord, embracing the Pod, which contains the Seed.*

φ φ. *The Pod.*

g. *The Pod with a Crack or Chink in it, to represent its being about to be divided into Two Hemispheres.*

h h. *The Chord expanded, approaching a right Line.*

i i. *The Two Hemispheres, when the Pod is divided in two.*

k. *The Seeds.*

l. *Seeds in the Pod, the Membrane being broke and turned up.*

VII. *Ex-*

VII. *Extract of a Letter from Jos. Ignat. de Torres, M. D. to the ROYAL SOCIETY, containing an extraordinary Case of the Heart of a Child turned upside down.*

Gandia in Valentia, March 19. 1738. N. S.

— **U**PON occasion of mentioning Anatomy, I am in Hopes you will not be displeased with an Account of a new and surprising Prodigy concerning the Heart, the like of which was never hitherto observed, till I saw it on the 29th of *December 1736.* in a new-born Female Infant of the Town of *Almoyna*, and faithfully delineated it. Innumerable *Phænomena* have been observed in the human Heart, some few of which I shall mention.

Ballonius saw a Heart so large, that its monstrous Size alone, without any Defect in the Lungs, occasioned an *Asthma*.

Bartholinus found *Caruncles* in the *Ventricles*.

Spilembergerus observed a small Bone therein, which occasioned a *Phthisis*.

Zacutus Lusitanus tells us from the Report of another Person, that a * Worm was found in the Left Ventricle, which brought on dreadful Symptoms. Its Head was yellow, its Body white, and its Tail split.

Riolanus opened the Body of a Man, whose Heart was cartilaginous.

According to *Raygerus*, the *Aorta* with the *Valves* was found ossified; which was the Cause of sudden Death.

Ge-

* Rather a *Polypus*.

Genesius of *Valencia*, a very able Physician, has apprised me in one of his Letters, that, upon opening his young Son, he found the Heart inverted; that is, the Left Ventricle on the Right, and the Right on the Left Side.

Amorosius saw a Heart with Two Points, which on the Outside shewed the Two Ventricles.

Sirenarius found a Heart with its Cone in the Right Side, and there the Pulsation was constantly felt.

Martinezius, First Physician to the King of *Spain*, observed in a new-born Male Infant, the Heart pushed out of the Breast, with its Cone and Basis lying horizontal, and without a *Pericardium*: A new and remarkable *Phænomenon*; as if the Heart, not bearing so close a Confinement, burst through the Breast, and, having broke the *Sternum*, appeared on the Outside.

I omit *Benivenus*, *Muretus*, *Scultetus*, and *Gierfsdorf*, who observed the Heart hairy, and found Stones, *Polypuses* and *Abscesses* in its Ventricles.

In fine, I have observed, in a new-born Female Infant, the Heart without a *Pericardium*, and turned upside down, so that its Basis, with all the Vessels, had fallen down as low as the Navel; and its *Apex*, still on the Left Side, lay hid between the Two Lungs. It would be a great Pleasure to me, to transmit this uncommon Observation to Posterity in a proper Light. But as it will require a Discourse too large for a Letter, and am apprehensive of being tedious, at present I only send you this Notice of it; but promise that as soon as I have finished a Dissertation thereon, which I have already begun, I will
send

send it to the ROYAL SOCIETY, with a Figure of the Infant, with the Parts in their proper *Site*. One thing I cannot pass in Silence, *viz.* how the Circulation could be carried on, the Heart being thus inverted; and yet the Child lived several Days after Birth. I observed the Heart from its Basis, whence the *Aorta* and pulmonary Artery spring, and where the *Cava* and pulmonary Vein enter it, to its Cone, surrounded loosely with several Windings of these Vessels, through which the Blood's Circulation must necessarily be performed. A wonderful Sagacity in Nature! but I shall reserve the rest for my Tract.

VIII. Johannes Castillioneus *D^{no}. de Montagny, V. D. Philosoph. Prof. in Acad. Lauzannesi, Reg. Soc. Lond. Soc. &c. de Curvæ Cardioide, de Figura sua sic dicta.*
S. P.

NON ignoro, V. C. novarum curvarum investigationem, tanquam nimis Analytici facilem, contemni: Cum tamen D. *Carré*, non mediocris Geometra Regiæ Scientiarum Academiæ, (28 Feb. 1705.) novam curvam, quanquam *vix summa sequens fastigia rerum*, proponere non dubitârit; cur tibi, viro in amicos benignissimo, nonnulla, quæ mihi ejusdem *Carré* dissertationem legenti venerunt in mentem, scribere non ausim? Sed procemiis omiſſis, ad rem.

Semicirculi *BMA*, (Fig. 1. 2. 3. TAB. III.) diameter *BA*, ita, puncto *B* peripheriam radens, ut semper
trans-

transeat per punctum A gignet curvam, de qua agitur.

Ex generatione patet,

1^o. Quod $DA\alpha$ normalis ad AB , æquat diametri duplum.

2^o. Quod hujus curvæ peripheria $ADNa\alpha NA$ finiet in A .

Curvam hanc a figura *Cardioïdem*, si placet, appellabimus.

Jam per a , & A ducantur aE , AQ normales ad aA , & ubi libet EN normalis ad aE : Ex genefi erit $AN = BA \pm AM$, & (per fimilitudinem triangulorum QAN , MBA) $AQ = BM \pm MP$, ac $NQ = MA \pm AP$.

Hæc eft præcipua hujus curvæ proprietas, altera non injucunda eft, quod recta NN femper æquat diametri duplum, & femper a circulo bifecatur in M .

Sit nunc $BA = a$, $aE = x$; $EN = y$, Erunt $QN = \mp y \pm 2a$, $AN = \sqrt{x^2 + y^2 - 4ay + 4a^2}$, & $MA = \mp a \pm \sqrt{x^2 + y^2 - 4ay + 4a^2}$; quæ quatuor lineæ per analogiam comparatæ, dant æquationem ad curvam.

$$y^4 - 6ay^3 + 2x^2y^2 - 6ax^2y + x^4 \left. \begin{array}{l} + 12a^2y^2 - 8a^3y + 3a^2x^2 \end{array} \right\} = 0$$

$$\frac{2y^4 - 9ay^3 + 2x^2y^2 + 12a^2y^2 - 3ax^2y - 4ay^3 = x}{6ax^2y - 2xy^2 - 3a^2x - 2x^3} = \frac{x}{y}$$

Sed ex curvæ generatione facilius ducendæ tangentis ratio deduci poteft. Veniat MAN in locum primo quamproximum man , fumantur $AR = AM$, & $Ar = AN$, & junctis MR , Nr , ducatur per A recta AT

AT iis parallela, & per Mm , Nn , rectæ MT , nt .
 Jam $nA : At :: nr$ (vel mR) : $rN :: mR \times MA :$
 $rN \times AM :: mR \times MA : MR \times AN :: MA \times$
 $Am : AN \times AT$, sed in ultima ratione $mA = MA$,
 & TA normalis ad MN , quare $nA : At ::$
 $\overline{MA}^2 : AN \times AT$; si nunc ex M ducatur per circuli
 centrum F , recta MF producenda, donec. rectæ TA
 item productæ occurrat in G , id est, usque ad circuli
 peripheriam, erit $\overline{MA}^2 = TA \times AG$; quapropter
 $nA : At :: AG : AN$; describatur igitur semicir-
 culus per G , & N , qui secabit rectam AT in t , ex
 quo ducta recta tN erit tangens ad curvam, ad quam
 insuper recta NG est normalis; hinc jungantur MO ,
 cui ex N ducatur parallela, quæ tanget curvam.

Hic obiter notandum puto hanc ducendarum tan-
 gentium methodum probe convenire pluribus curvis.

Sit AB , Fig. 2. Conchois Nicomedæ: Tunc
 (supposita superiori præparatione) $BP : Pt :: BR$,
 (vel cr) : $Rb :: cr \times CP : Rb \times CP$, (vel $rC \times$
 PR) : $\overline{CP}^2 : TP \times PR$, unde deducitur superior
 constructio.

Recta longitudinis datæ Fig. 3. CPB , extremitate
 C radens rectam CDT ad DA normalem, semper
 transeat per punctum P datum in ipsa DA , & ita
 curvam AB gignat.

Superiorem præparationem, & ratiocinium huic
 aptans habebis $BP : Pt :: bR$ (rc) : $RB :: cr \times$
 $CP : RB \times CP$ ($BP \times rC$) : $\overline{CP}^2 : BP \times PT$,
 ut supra. Piget plura referre.

Cæterum methodus de *maximis*, & *minimis* dat
 maximam ordinatam $= \frac{9a}{4}$, & ejus abscissam $= \frac{a}{4}\sqrt{3}$.
 Posset eodem pacto investigari abscissarum maxima;
 sed

sed *longæ ambages, series sed longa laborum*; quare sic eam quærito.

Quia EN , Fig. 1. est tangens ad curvam, recta MG ex puncto M per centrum F ducta determinat punctum G , ex quo ducta GN est normalis ad EN , ergo & ad Aa , ex hypothesi, sed $NQ = AV = MA + AP$; ergo $VP = MA$; atqui $BA : AM :: MA : AP$; ergo $BA : PV :: VP : PA$; sed $PF = FV = a - 2z$; & ideo $a : a - 2z :: a - 2z : z$. Unde facile deducitur $z = \frac{a}{4}$, $EN = \frac{7a}{4}$, $AQ = \frac{3a}{4}\sqrt{3}$. Ubi notandum quod idem punctum M , quod præbet in recta $NAMN$ punctum majoris ordinatæ, præbet etiam punctum majoris abscissæ.

Sed jam satis patientia tua abusus videor: quare finem faciam, nonnulla alia, quæ de hac curva commentatus sum, propediem missurus, si putes hæc & similia non indigna, quæ a te subcivis horis legantur. Vale,

Vir, quo neque candidiorem
Terra tulit, neque cui me sit devinctior alter.
Viviaci, pridie Kalendas Apriles 1741.

IX. *Ad Eclipses Terræ repræsentandas, Machina J. And. Segneri, Med. Physic. & Mathem. Prof. Goetting, R. S. S.*

UT eclipsis aliqua terræ oculis exhibeatur spectanda, projectio arcuum & circulorum, qui in hemisphærio terræ illuminato concipiuntur, in planum, servire potest egregie: Sique in ejusmodi projectionem

jectionem loca etiam inferantur in superficie terræ sita, urbes puta, littora, insulæ, reliqua, addaturque circulus, penumbrae lunaris positum atque magnitudinem exprimens, eique concentrici minores aliquot, uno obtutu lustranda depinguntur loca terræ, quibus eo tempore plane tegitur Sol a Luna, & quibus quælibet ejus pars visui subducitur.

Verum momentanea est ejusmodi imago, cumque ea, quæ aliquo temporis articulo adparent, eo verbi gratia, quo centrum penumbrae lunaris discum terræ primum ingreditur, cum magna adcuracione sistat; phænomena reliqua, prout partim a rotatione terræ, partim a motu lunæ, pendent, exhibere non potest: ut illi, qui omnes omnino eclipses adparentias, quemadmodum sese ordine excipiunt, exhibere hoc modo vellet, plurimæ projectiones delineandæ forent; quæ res maximi laboris est, quemque sperata ex eo voluptas compensare vix potest.

Rotata terra iidem quidem manent latitudinum circuli, eademque adeo horum projectio, sed meridiani, sive circuli longitudinum, mutantur assiduo, horumque projectio, & situs locorum terræ, quatenus ab his pendet. Quæ considerata, cum aliqua laboris compendia offerre queant, tum, quantum ejus relinquatur, clare docere.

Sed globus terrestris artificialis hemisphærium terræ, a sole quovis tempore illuminatum, minimo labore exhibet. Elevato enim polo supra horizontem, vel infra cum depresso, sic, ut ea elevatio vel depressio sit declinationi solis, ad datum illud tempus, æqualis; vel, quod eodem redit, collocato loco solis in eclipctica globi in ejus Zenith; horizon artificialis finitor sit lucis & umbræ, qui nempe hemisphærium terræ
illu.

illuminatum ab obscuro distinguit, nihilque superest, quo hemisphærium illuminatum plane exhibeatur, quam, ut circa axem suum rotetur globus, donec eum obtinuerit situm, quem hora diei requirit.

Atque ita, quod in projectionibus difficillimum est, per globum facillime perficitur, naturæque etiam, quam per illas, convenientius. Quod cum pensitarem, illud verum superesse vidi, quo per globum eclipseos terræ cujusvis omnia phænomena exhibeantur, uti penumbra lunaris in eum projiceretur, utque machina fieret, qua ejus situs ad quodlibet tempus repræsentari, eaque ad loca terræ in globo designata referri possit. Qua rei facilitate illectus sum, ut de ejusmodi machinamento cogitarem: idque eum in modum, quem figura adjuncta TAB. III. Fig. 4. exprimit, efficere sum conatus.

Ea globum terrestrem sistit, vulgarem, horizonte suo atque meridiano, circulum gerente horarium, instructum. Horizonti connexa sunt duo brachia lignea, *AB, ab*, Fig. 4. TAB. III. ejus longitudinis, quæ paullulum excedit semidiametrum globi. Eorum brachiorum extremitates alteræ, *ACD, ac*, ita factæ sunt, ut comprehendere horizontem possint, & cochleis, quarum una apud *D* comparet, ad quodlibet ejus punctum firmari.

Oppositis vero brachiorum extremis, *B, b*, fulcra insistant, lignea pariter, horizonti perpendicularia, *BE, be*, ejus altitudinis, quæ semidiametro globi, cum latitudine meridiani ænei, æqualis sit, sic, ut ducta per summa fulcrorum linea recta, meridianum contingere nequeat.

Teguntur fulcra orbiculis æneis, quos axes perforant ferrei, utrinque prominentes, & firmiter cum
or-

orbiculis juncti. Eorum axium partes inferiores, fulcris, secundum horum longitudinem inserti, firmantur: quare & orbiculi, situ cum horizonte globi parallelo, redduntur immobiles.

Superiores axium partes teretes sunt, & pariter atque orbiculorum superficies superiores, politæ: excipiunt autem trochleas æneas EFG , efg , orbiculis impositas, sic ut motæ utcunque circa axes, plano horizontis parallelæ sint. Diametri trochlearum sunt trium fere pollicum, & peripheriæ crenam quæque suam habent, excipiendo filo servituram. Paullo minor est trochlea efg , altera EFG ; nihil enim ex diversitate ista magnitudinis machina detrimenti capit: præterea vero nihil habet singulare; itaque orbiculo tantum ad b opposito, ne axe excidat, firmatur.

Verum altera trochlea, EFG circulum inscriptum habet, in suos gradus divisum, quod ob compendium laboris factum est, cum in partes quocunque numero alio, dummodo satis minutæ essent, eodem effectû potuisset secari; adpositusque est indiculus H , numerum earum partium ostensurus: qui quidem ita cum axe cohæret, ut moveri circa eum, cum aliqua difficultate, possit; sed sic tamen, ut nec indicis motus motum trochleæ afficiat, nec vicissim, trochlea mota, index e loco suo deturbetur. Itaque inter trochleam & indicem orbiculus minutus immobilis interpositus est, & index ad axem ita firmatus, ut elatere quoquo versus immobilem eum orbiculum prematur.

Tres deinde radii ænei, ik , il , im , in i connexi, habentur, æquales angulos, kil , lim , mik comprehendentes; locus autem i foramine minimo pertusus est.

est. Elastici sunt radii, & quantum per firmitatem fieri potuit, tenues, longitudine vero ik , sive il , aut im , ea quæ quartæ parti diametri globi proxime æqualis est. Et hoc penumbrae ferendæ quasi sceleton reliquis sic adplicatum est. Porro radii foraminula habent apud l & m , per quæ traductum filum trochleis circumpositum est secundum $mEFGgfel$, extremis inter l & m firmiter colligatis: quare sceleton quoque ad partem fili $elmE$ redditur immobile, radio ejus tertio ik parti fili gG libere incumbente: itaque efficitur, ut, rotata trochlea EFG vel efg , sceleton ultro citrove, secundum lineam rectam, moveatur.

Explorari his ita constructis potuit, quot partes divisionis trochleæ EFG responderent globi diametro, hunc in modum. Brachia AB , ab , collocata sunt ita, ut, moto sceleto, centrum ejus i diametrum globi percurreret; idque ut effici posset, horizonte globi, situ cum horizonte terræ parallelo, collocato, demissum ex eo centro est pendulum in , puncta horizontis ostensurum, quibus centrum immineret. Itaque, promotio centro secundum totam diametri globi longitudinem notari potuit numerus partium trochleæ EFG , quæ per indicem H interea transierunt; qui sollicitè observatus, memoria retinendus fuit, cum ejus usus, ut & reliquorum omnium quæ adhuc descripta sunt, in omnibus eclipsibus repræsentandis, recurrat. Quæ sequentur, mutari, pro qualibet eclipsi singulari, debent.

Eorum autem primum est, discus penumbrarum, quem ita efficere conatus sum. Reperta ex tabulis, ad eclipsim, quam exhibere volebam, penumbrae lunaris in disco terræ semidiametro, ut & parallaxi lunæ horizontali, sic sum argumentatus: ut parallaxis
lunæ

lunæ horizontalis, ad radium disci penumbrosi; sic semidiameter globi terrestris quo utebar, ad quartum, qui radium exprimebat penumbrae, quam globi magnitudo requireret.

Diviso eo radio, habita etiam prout convenit ipsius umbræ ratione, in sex partes, (nam in duodecim dividere modulus machinæ prohibere videbatur) circulos descripsi concentricos in charta spissiore, & secundum eos chartam in armillas dissecui. Harum maximam scelecto *k l m* ita adglutinavi, ut centrum armillæ centro scelecti *i* congrueret, alteram ab hac rejeci, tertiam scelecto adglutinavi eodem modo, rejecta quarta, pariterque quintam, rejecto circello intimo; sic ut figura oriretur, qualis inter *k l m* picta est, ejus usus, ut omnibus secundum ea, quæ dicenda restant, compositis, loca in globo designata, quæcunque perpendiculariter subjecta sunt exteriori maximæ armillæ margini, initium videre eclipses vel finem, ostenderet; quæ sub margine ejusdem armillæ interiori sita sunt, eclipsim cernere duorum digitorum, quæ sub margine exteriori armillæ secundæ, eclipsim habere quatuor digitorum, & ita porro; quæ vero sub centro posita sunt, totius solis deliquium pati: Nam umbram, propter parvitatem, per ipsum centrum designasse, fatis habui.

Componuntur autem omnia pro quolibet eclipses datæ momento, hunc in modum. Repertis calculo punctis finitoris lucis & umbræ, quibus centrum lunæ discum terræ primum ingreditur, ex eoque iterum exit, hæc notantur in horizonte globi, & brachia *AB, ab*, (Fig. 4. TAB. III.) collocantur, sic, ut, revoluta trochlea *EFG*, centrum *i* disci penumbrae *k l m* super illa transeat, quod an fiat, pendulum *in* ostendit. Tempus deinde reperio, quo centrum penumbræ

bræ in loco aliquo versatur notabili, ut, quo discum terræ primum ingreditur, globumque, meridiani, atque æquatoris, sine circuli horarii ope, ita colloco, ut hemisphærium terræ a sole eo tempore illuminatum, ejus pars supra horizontem eminens, exhibeat. Trochleam autem *EFG* revolve, donec centrum penumbræ *i* notabili illi loco, ut in nostro exemplo finitori lucis & umbræ, ad perpendicularum sit impositum; quem ejus situm voco primarium, eoque obtento indicem *H* trochleæ, initio divisionis admoveo. Sic rite ad hoc tempus composita habentur omnia, possuntque ejus phænomena colligi.

Jam, ex tabulis excerpto motu lunæ a sole horario, intero, uti parallaxis lunæ horizontalis ad motum hunc lunæ horarium; sic numerus partium trochleæ *EFG*, qui respondet semidiametro globi, supra repertus, ad quartum, qui indicat, quot partes, trochlea revoluta, per locum indicis traducendæ sint, ut habeatur situs disci penumbræ, una hora ante vel post tempus, quod primario situi respondet. Collocato ergo disco in hunc locum, rotatoque circa axem globo, uti par est, hujus temporis phænomena haberi pariter possunt.

Reliquorum jam temporum situs obtinentur facile. Diviso enim numero partium trochleæ proxime reperto, qui nempe motui horario respondet, ut habeatur motus semihorii, quadrantis horæ atque minuti horarii, tabula construi sola additione atque subtractione potest, in qua, notatis temporibus partes appositæ sunt trochleæ quibus discus penumbrarum moveri antrosum retrorsumve debet, ut situm accipiat, qui illi tempori convenit. Qua perfecta nihil opus est, quam ut globus secundum tempus rotetur, trochlea

vero sic, ut index ejus numerum tempori adscriptum ostendat. Prius illud, si usus circuli horarii concedatur, imprimis expedite, fit, si horæ ordine retrogrado adscribantur, utpote motui terræ circa axem suum adcommodato, qui & in figura expressus est.

Loca tandem in superficie globi designata disco penumbræ in quovis ejus situ perpendiculariter subiecta, pendulo explorari possunt. Sed uno intuitu lustrantur, toto adparatu radiis solaribus, si commodum visum fuerit, a speculo plano reflexis, ita exposito, ut hi ad horizontem globi perpendiculares incidant. Hoc enim facto a disco penumbrarum in globum umbræ projicientur, earum æmulæ penumbrarum, quas luna in terram projicit, ex quibus phases eclipsis, cujusvis loci, qui illis involvitur, perspicere possunt.

Incommodus hic est motus solis; ei, qui vitro ustorio majori instructus est, lampadem fortasse non inepte substituet, cujus radii a vitro in globum, ejus horizonti normales, projiciantur. Cogitavi quoque de globo eminus per tubum opticum spectando, qua methodo ipse discus *k l m* in globi superficiem relatus, penumbram exhibet. Verum ad id telescopio amplioris campi opus est: remoto enim adeo globo, ut totus conspici per telescopium minoris campi possit, verendum est, ut loca in eo designata visu distinguere nequeant.

Cogitavi de motu machinæ conciliando, median-
tibus duobus horologiis prorsus a se invicem separatis, quorum alterum globum converteret, alterum trochleam: quæque ut legitime conspirarent, per pendula efficeretur. Verum magis mihi convenire videtur,

videtur, ut veniam eorum, quæ fortasse perperam dicta sunt, submisſe petam, quam ut iis jam plura addam.

X. Samuelis Chriſtiani Hollmanni, *Logic. & Metaph. in nova Gottingenſi Academia, P. P. O. Obſervatio de Sceletorum, ex Foliis virentibus paratorum, quorumcunque Dupli- catura.*

EX quo illa *foliorum*, uti vocant *sceleta*, quæ, quantum conſtat, a celeberr. RUYSCHIO, magno illo verioris corporum ſtructuræ indagatore, primum omnium elaborata ſunt, primum etiam vidi; vidi autem apud virum, quem honoris cauſa hic nomino, celeb. ABRAHAMUM VATERUM, *Anatomie & Botanices profeſſorem in academia Vitembergerſi* meritiſſimum; neſcio quæ & admiratio ejus rei, & cupido modum, quo illa præparentur, inveſtigandi, me inceſſerit, quod admirabilis illa, vereque ſtupenda, quæ in foliis ejusmodi, ut loqui ita fas ſit, excarnatis deprehenditur fabrica tot præclara ſapientiſſimi potentiſſimique Conditoris veſtigia, unico quaſi obtutu conſpicienda nobis præbet, ut dolendum fere ſit vel unicum ex infinito fere illo diverſiſſimorum foliorum genere numeroque debere prius perire, certaſque putrefactione in terræ ſinum recondi, quam admirabilem iſtam ſuam fibrillarum minimarum ſtructuram hominum oculis contuendam ſubjecerit. Multa propterea, iterataſque induſtria, pro eo, quo in contemplandas res naturales feror, ardore, pericula feci, quibus ſcelera

illa parari, maximumque Conditoris sapientissimi in illorum constructione latens artificium, *nudum* quasi, atque ex involucris suis in lucem protractum, conspiciendum præberi aliis posset. Eram quoque jam in eo, ut, quod mihi in excarnardo aliquo *pulmonum*, cera injecto lobo feliciter jam brevi antecesserat, post alia frustra, nulloque successu, instituta tentamina, etiam hic *fermentationis & putrefactionis* lentæ vim experirer; feliciterque jam quodammodo negotium successerat, quum ex *eodem doctissimo*, mihiq; amicissimo, *viro* perciperem, & putrefactione omnino id perfici debere, & totum, quo fieri idem feliciter posset, processum in *commercio liter. physico-medico* quod *Norimbergæ* vulgatur, descriptum extare, ubi eundem etiam *a. 1732. hebdomad. 4. p. 73. & hebdom. 34. p. 267. sq.* expositum postea deprehendi. Eo ergo securior jam de methodo, qua uti cœperam, factus, ulterius, non infelici successu, sum progressus: præparavi ex variis foliorum generibus *sceletæ* non solum, sed & *cuticulam utramque* folio cui-cunque utrinque arctissime inhaerentem; & separavi facile, & feliciter etiam, qua omnes suas dimensiones explicatam, exsiccavi. Nihil tamen his omnibus hætenus feceram, quin observatum jam descriptumque, locis modo excitatis, idem extaret. Brevi vero post aliquid ex improvise mihi accidit, de quo mihi nondum constat, num a quoquam, ante me, alio in foliorum anatome jam observatum unquam sit. Etenim dum in folii alicujus præparatione occupor, resque illa minus mihi ex voto succedit, folium, isthoc, in partes varias discerptum, lacertumque, impatientia abreptus, in vas, proxime adstans, impuritatibusque recipiendis destinatum, abjicio,

atque

atque ad alia quædam præparanda jam convertor. Subiit me tamen, nescio qua de causa, mox cupido, partes folii istius dilacerati quasdam microscopio subjiciendi, quidve in iisdem deprehenderem, attendendi. Neque vanus ille labor fuit. Non sine insigni enim admiratione mea deprehendi, violenta illa tenerrimarum fibrillarum laceratione partes, artissime sibi alias impositas, jam a se invicem divulsas, seorsumque distinctissime conspiciendas, sissi, sicque per *universum* folii istius lacerati *ambitum* aliquam *fibrillarum* quarumcunque, majorum minorumque, *duplicaturam* observari. Hæsitabam initio, annon violenta isthac laceratione effectum, productumque aliquid in illa folii parte esset, quod naturali ejusdem constitutioni repugnaret, illaque adeo fibrillarum quarumcunque duplicatura adhibitæ potius vis, quam ipsius naturæ opus esset: brevi tamen posthæc dubitatio isthæc omnis expiravit. Postquam in aliis enim, quæ ad manus adhuc erant, foliorum sceletis, nondum exsiccatis, tentaveram, annon fibræ illæ quibus constabant, tenuissimæ separari se sine magna vi sinerent; deprehendi, in foliis, ad *illum* putrefactionis *gradum* jam perductis, ut utraque cuticula nullibi, quam in extremo folii margine, ipsi folio amplius adhæresceret, post ejusque adeo separationem materia illa folii viridis, sub eadem latens, putrefactione jam resoluta, sponte efflueret, *pediculum* quoque, sua non minus sponte, in *duas partes* secedere, & detracta cuticula, quæ & ipsi incumbit, quasi jam hiare, quarum utraque si seorsim digitis leniter comprehendatur, alteraque ab altera sensim paulatimque divellatur, *peculiare* quoddam, atque *separatum*, fibrillarum subtilissimarum *reticulum* cuilibet illarum annexum esse, quod

quod facillime ab altero secedit, cujusque singulae divaricationes, & quasi ramificationes fibrillarum, *alterius* reticuli divaricationibus adeo exacte *respondent*, iisdemque adeo arctissime adjacent, ut *unicum* quoddam reticulum quoque, ante separationem suam, propterea modo efficere videantur. Postquam hoc ergo in quamplurimis jam hoc modo feliciter successerat; observavi porro, in aliis, in sceleta mera jam redactis, & post illud tamen tempus, ad facilitandam illam reticulorum minimorum a se invicem separationem aqua aliquamdiu adhuc maceratis foliis, imprimis vero in *extremis* illorum *apicibus*, reticula illa *sua sponte* jam paulisper a se invicem recedere, alterumque illorum ab altero, quando in aqua limpidissima leniter hinc inde agitantur, reipsa *jam separatum* esse, manifestissime deprehendi. Sceleton ergo ejusmodi alterius manus digito quodam sub aquam demersum, fundoque vasis affixum, tenui; altera interea temporis manu mediante scalpelli cuspide, superius reticulorum istorum, sponte a se invicem recedentium, elevare tentavi, donec comprehendi illud leniter digitis posset; tumque alterum inferius alio quodam digito ad fundum vasis deprimere, ibique quasi affixum tenere, sicque alterum reticulorum ab altero, facto ab *apice* folii initio, leniter divellere laboravi; quod etiam non minus tandem feliciter successit, eademque & hic singularum divaricationum & ramificationum utriusque reticuli exacte sibi mutuo respondentium, distributio mihi observata est.

Quum hac igitur ratione reticula ista diversa, in quovis sceleto praesentia sua sponte ita a se invicem recedere, plus simplici vice deprehendissem; non dubitavi amplius, neu *vis*, quam antea adhibueram,
aut

aut *artis*, sed *naturæ* potius, opus illam tenuissimarum quarumcumque fibrillarum in quovis folii sceleton *duplicaturam* esse; sicque, quodvis ejusmodi sceleton duplici istiusmodi fibrillarum reticulo naturaliter constare, satis jam superque convictus fui. Magis tamen isthac in sententia postea confirmatus adhuc sum, postquam microscopio observavi, *singulas* in *alterutro* folii hujusmodi duplicati reticulo majores, minoresque, fibrillarum divaricationes incilium alveorumque instar *excavatas*; in *altero* vero, contra, semper tali *convexitate* donatas, easdem esse, ut harum *convexitates* illarum *concavitatibus* quam accuratissime respondeant, hæque adeo illorum sinu ita excipiantur, includanturque, ut quamdiu sic inter se cohærent, simplicem quandam fibrillam referant, nullaque in iisdem duplicaturæ cujusdam vestigia appareant. Adeo manifestæ vero hæ convexitatibus suis respondentes concavitates in foliis, ita præparatis, sunt, ut in foliis, quæ hic adjeci, duplicatis vel medio ocri bonitatis microscopio facile observari a quolibet, qui ad isthac modo attendat, possint. Neque difficile etiam cuiquam erit, ipsum in hac foliorum divisione id experiri, quod descriptum hætenus a me est, modo sceleta ipsa præparandi artem prius rite tenuerit, ipseque jam periculum ejus rei fecerit; deinde vero & folia ad justum putrefactionis gradum, supra jam a nobis indicatum, pervenire permiserit, totamque operationem in vasculo, non ultra *sex* vel *octo* circiter *lineas* profundo, & aqua limpidissima repleto, susceperit: tum enim ex voto facile omnia succedere observabit.

Foliorum, quæ hic adjeci, *primum* sub *A*, in TAB. IV. nudum sistit sceleton more, supra indicato, a me præparatum,

ratum, in quo *nulla divisio* tentata est. Alterum, sub *B*, *divisum* magna sui parte fuit; post divisionem vero alterum reticulorum alteri ita iterum superimpositum aquæ, in qua tum natavit, adminiculo, est, ut pediculi partes data opera ad latus oppositum paululum utrinque inclinarentur, quo sic divaricationes singulæ utriusque reticuli eo melius possent conspici, sicque totum postea sceleton istud exliccatum est. Hoc ipso vero jam distinctissime apparet, *singulis* unius reticuli *divaricationibus*, majoribus minoribusque *totidem*, *eodemque ordine*, in altero reticulo *alias* majores, minoresque, semper *respondere*, neque ullam illarum suo quasi comite destitui.

Tertium, quod sub *C* adjectum est, folii sceleton, methodo hætenus descripta, a *caule*, vel *pediculo*, versus *apicem* folii pergendo, ita divisum est, ut alterum reticulorum ab altero, quousque separata illa fuerunt etiamnum actu ipso elevari, & dimoveri, possit, reliquis utriusque reticuli partibus arctissime adhuc inter se cohærentibus, unicumque simplex reticulum modo repræsentantibus, quo ipso duplicatura ista ad oculum demonstrari cuivis potest.

Quartum, quod sub *D* deprehenditur, sceleton eodem modo, sed ab *apice* ad *caulem*, vel *pediculum* folii progrediendo, divisum ita est, ut altera lamella dimoveri adhuc ab altera possit: partes vero pediculo propinquiores iterum sine separatione omni sibi mutuo cohærentes relictæ sint.

Quintum, quod sub *E* adjectum folium est, qua *alterum* suum *latus*, pediculo adjacens, divisum modo est, unde & hic elevari modo alterum reticulum ab altero potest; alterum vero ejusdem latus in statu, situque, suo naturali relictum adhuc est.

Sextum,

Sextum, quod sub *F* conspicitur, folii ſkeleton præter reticulorum, ab invicem ſeparatorum, duplicaturam, verſus *apicem* ejus inprimis conſpicuam, etiam *utramque* folii *cuticulam*, utramque ejusdem ſuperficiem obtegentem, exhibet, quæ adeo tenuis eſt, ut vel flatu incautiori lædi facillime poſſit.

Septimum tandem, quod ſub *G* videtur ſkeleton, nullam quidem reticulorum duplicaturam conſpiciendam exhibet; præter *cuticulam* tamen *utramque*, folio ipſi ſuperne, inferneque incumbentem, etiam *caulis* ſeu *pediculi*, quæ illum undequaque ambit, *cuticulam* conſpiciendam ſiſtit, ipſiusque *pediculi* in *duas* illas *partes*, quibus reticula ipſa artiſſime adhærent, *diviſionem* exhibet, quarum altera *convexa*, altera *concava*, microſcopio obſervata apparet, niſi in quantum partis concavæ figura ipſa exſiccatione pauliſper congrugata, eoque ipſo immutata eſt.

Omnia vero hæc folia ex illo arborum genere quæ *Pyri Francicæ* nomine in genere vulgo venit, ejusque variis ſpeciebus, deſumta ſunt, quippe quæ ex omni foliorum genere ad has operationes quam accommodatiſſima eſſe, experientia, fruſtraque in aliis multis tentata conamina, me tandem docuerunt.

Hæc ergo hætenus de *ipſa* foliorum duplicatorum *ſtructura*. De *partium* vero illarum, *duplicaturæ* inprimis, iſtius, *uſu*, conjecturas quaſdam feliciffimo Illuſtris SOCIETATIS REGIÆ judicio peculiari quadam obſervatione, ne nimis jam prolixus ſim, ſubmittam.

XI Samuelis Christiani Hollmani, *Logic. & Metaph. in nova Gottingensi Academia, P. P. O. de Duplicaturæ fibrarum, in foliis quibuscunque conspicuæ Ufu, aliisque huc pertinentibus, Conjecturæ.*

QUUM illa, quæ de *duplici* in foliis quibuscunque minimarum fibrillarum *reticulo*, facile a se invicem separabili, & a natura ipsa distincto, in superioribus annotata sunt, extra controversiam, & dubitationem omnem, videantur esse posita, atque oculari demonstratione confirmari facile cuivis possint; operæ jam videtur esse pretium, paucis hic exponere, *Quisnam* verus hujus *duplicaturæ* videatur esse *usus*. Non putamus vero, quenquam, in rerum naturalium contemplationibus vel mediocriter versatū, adeo temere in plantarum anatome fore hospitem, ut ignoret, plerasque in plantis occurrentes fibras ligneas, hisque analogas, *tubulos*, & *canaliculos*, quamplurimos minimos efficere, quibus succus nutritius, inde ab extremis radicum fibrillis, ad remotissimas quascunque partes, vehitur, atque a principio suo movente, quodcumque tandem illud quoque sit, propellitur quasi, protruditurque. Neque qui hæc noverit, etiam temere ignorabit, *fibrillas* illas minimas, quibus *caulis*, vel *pediolus*, foliorum constat, canaliculorum illorum minimorum *elongationem*, & *continuationem* quandam, solum esse, & *peculiarem* quandam eorundem *fasciculum* quasi constituere, quibus succus nutritius ad partes folii reliquas transmittitur, per easdemque distribuitur; quique per varias divaricationes, & quasi ramificationes, per universum folii

folii planum postea *explicantur*, atque a se mutuo magis magisque recedunt, variis tamen *anastomosis*, multis in locis, sibi mirifice iterum simul *inosculantur*, sicque inter se *cohærens* quoddam fibrillarum, & tubulorum minimorum *reticulum* constituent. Hoc enim omne in foliis quibuscunque etiam non excarnatis, si luci copiosiori obvertantur, etiam nudo oculo, vel mediocri microscopio observari a quovis facile potest. Neque illud tandem quoque quenquam, rerum naturalium vel mediocriter saltem peritum, latere posse existimamus, quod jam proxime elapso seculo multi viri celeberrimi in eam ingressi sint sententiam, quod succus nutritius in *plantis* non alia, quam in *animantibus*, ratione, hoc est, *per circulum*, moveatur; quodque coram ipsis *Societatibus Regiis*, LONDINENSI & PARISIENSI, varia maximam huic sententiæ veri speciem conciliantia, tentamina & experimenta jam olim, recentiusque, instituta sint. Hæc omnia ergo, quando de usu duplicaturæ in foliis, eorumque minimis quibuscunque fibrillis, dicere jam instituimus, tanquam aliunde satis cognita, & fere jam pervulgata, hic merito supponimus.

Facile vero jam, his præstructis, videri cuiquam poterat, non posse temere luculentius quoddam, quo illa in dubium a multis adhuc revocata, *succi nutritii* in *plantis circulatio* confirmari, & extra controversiam omnem poni facilius possit, inveniri argumentum, quam *hanc ipsam* reticulorum in foliis quibusvis *duplicaturam*. Quod si *singulæ* enim istius reticuli *fibræ* totidem *tubuli* sunt, quibus succus nutritius in folium ipsum ascendit, & per illud distribuitur, de quo nemo fere dubitat, atque horum tubu-

lorum talis jam duplicatura perdemonstrata datur, ut *ne minimus* quidem sit, qui non *comitem* suum, exactissime sibi respondentem, habeat; nihil fere manifestius jam esse videtur, quam *alterum* illorum genus *arteriarum* quasi, *alterum* vero *venarum*, officio hic fungi, quippe quas eodem modo in corpore animali se perpetuo comitari mutuo, constat; adeoque & *alterum* illorum succo nutritio a radicibus ad extremos usque apices *advehendo*, *alterum* vero eidem ab extremis arborum & plantarum apicibus ad radices *revehendo*, inservire; sicque motum ejusdem *circularem*, hoc ipso diverso tubulorum genere, in plantis & vegetabilibus perfici.

Non est ille hic locus, quo disquiri jam a me vel possit, vel debeat, quid mihi illi, de succi nutritii in plantis circulatione, sententiæ veri videatur subesse, vel minus, quidque in experimentis, ejus confirmandæ rei causa institutis, vel dubium, vel uberiori saltem disquisitione dignum, adhuc esse videatur; de quo alio forsitan & loco, & tempore. *Ponamus* vero, extra omnem dubitationem jam esse positam illam succi nutritii in plantis & vegetabilibus circulationem; *hæc* tamen tubulorum, si ita appellare licet, in foliis a me jam observata *duplicatura* huic sententiæ *non* omnino videtur *favere*, quam maxime id etiam vellem: majorem enim forsitan tunc apud multos hoc novo invento inire gratiam, quam nunc quidem. Etenim *initio* nondum satis evidens, & dubitatione omnino carens, esse videtur, quod *reticuli cujusvis*, separatim spectati *fibrillæ*, illarumque divaricationes, *integri tubuli*, totidemque tubulorum integrorum ramificationes sint, siquidem in ejusmodi fibrillis, transversim dissectis, vel disruptis, *nulla* hæcenus tubulorum quorundam *orificia osculaque*, qualia quidem in *quo-*
rumvis

rumvis lignorum fibris, transversim, seu horizontaliter, dissectis, facili observare negotio licet, vel optimæ notæ microscopiis detegi, a me potuerunt. Forsan ergo, dum pars alterutrius reticuli *convexa*, partis alterius *concavæ sinu* quasi excipitur, arctissimeque includitur, *tenuis* aliqua, *insensibilisque*, solum *cavitas* inter utramque relinquitur, quæ transmittendo succo nutritio inservit; hocque adeo modo divaricationes *utriusque* reticuli inter se *conjunctæ*, *tubulorum* demum officio defunguntur. Quodsi vel maxime vero, non obstantibus modo adductis, vellemus concedere, *singulas* utriusque reticuli *fibrillas* totidem integros, perfectosque, *tubulos*, quibus singulis succus aliquis nutritius transmittatur, perque universi folii substantiam distribuatur, esse; *ne sic* tamen arbitror, confici statim exinde poterit, *alterius* reticuli tubulos *arteriarum*, *alterius* vero *venarum*, officio fungi, sicque succum nutritium in his reticulorum tubulis *per circulum* moveri. Duo enim in primis in isthac foliorum præparatione supra jam commemorata, & descripta, observavi, quæ huic sententiæ minime videntur favere. 1º. Scilicet deprehendi, minimas utriusque reticuli fibrillas, in *extremo* folii *marginè* sitas, terminatasque, longe *facilius* a se invicem separari posse, *suaque* quasi *sponte* jam recedere, quam quæ *a marginè* undequaque *remotiores* sunt, & longius ab eodem distant; etsi *cuticula* utraque in *extremo marginè* arctissime undiquaque adhuc inter se *cohereat*; indeque & licet ab utroque folii reticulo, per totum ejus ambitum, sua sponte jam recesserit, *hic* tamen cultello adhuc *diffecanda* studiose sit, si altera ejusdem lamella recedere ab altera debeat: id quod evidentissimo videtur esse argumento, *fibrillarum*
utri-

utriusque reticuli *extremities* in *marginē* folii *non* inter se *cohærere*, atque *arteriarum* instar in *venas* suas *recurvari*, *replicarique*, siquidem omnium arctissimè aliàs tubuli isti subtilissimi, hoc imprimis in loco, cohærere inter se deberent. 2º. Illud quoque annotatione dignum hic est, quod non raro mihi evenisse memini: Contigit nempe aliquoties, ut, quando altera folii, aquæ innatantis, superficies durante putrefactionis tempore ex aqua aliquantulum prominuit, *hæc ipsa* superficies quoque tum *minus*, quam *altera*, sub aquam depressa, eademque undiquaque contexta *putrefactione* ad sceleti præparationem *apta* facta fuerit, difficiliusque & cuticulam, ipsi impositam, dimiserit, & partes viridulas, inter reticuli lacunas interpositas, elui aqua permiserit, quam in *altera* quidem ejusdem folii superficie utrumque successit. Hoc ergo quando jam evenit, microscopio aliquoties observavi, *inferius*, si putrefactionis situm, statumque, respicias, ejusmodi folii reticulum *omni*, inter ipsas ejusdem divaricationes & lacunas aliàs hærente, pulpa viridula *denudatum* jam conspici, *hærente* eadem adhuc, intimeque *infixa*, intextaque, inter *alterius*, *superioris* nempe eodem respectu, reticuli divaricationes, & lacunas: id quod quilibet, qui manum modo ipsi rei admoverit, facile ipse quoque, data occasione, observare poterit. Quum ex hoc ipso ergo evidens satis sit *ipsam* etiam *pulpam* illam subtilissimam *virescentem*, quæ utrique folii cujuscunque cuticulæ proxime subjacet, eademque separata sponte sua, maximam partem, plerumque, post debitam putrefactionem, effluit, in *duas* non minus *lamellas*, & *strata* quasi totidem *diversa* distinctam esse, quorum alterum *uni*, alterum *alteri*, folii reticulo intime, arctissimeque, intertextum quasi

quasi est; maxime etiam videtur esse evidens, *alterum* folii *reticulum* generandæ & nutriendæ *uni*, alterum *alteri*, foliorum quorumvis *superficie* inprimis invadere, huicque usui a Creatore sapientissimo destinatum etiam potissimum esse.

Quum hac ergo ratione de Duplicaturæ istius, in foliorum quorumcunque sceletis, usu jam quodammodo constet; *alia* nonnulla ad hoc argumentum pertinentia hic adjicere adhuc liceat, quorum primum *generationem pulpæ* istius *viridulæ*, quæ inter reticuli utriusque lacunas, in folio virescente, utrinque interjacet, inprimis concernit. Constat mihi scilicet ex plurimis circa plantas & vegetabilia institutis & observationibus & experimentis, *primum*, quod ex succo nutritio in vegetabilibus procreatur, *concretum* formam quandam *vesicularem*, & *utricularem*, semper præ se ferre; unde & dudum *utriculorum* nomine a veterum istarum peritis scriptoribus compellatum idem est. Patet id ex *medulla* quarumcunque arborum, patet ex *cortice* earundem *viridi*, patet ex *florum*, ex terra *immediate* prognatorum plerorumque, *caulibus*, ipsisque *horum*, & ex *arboribus* protrulorum, *florum*, tum & reliquis *communibus* plantarum quarumcunque, *foliis*, in quibus vel nudo sæpius oculo utricularis, & vesicularis, illa figura conspici facile potest. Jam vero, experientia porro constat, quod, quotiescunque *liquidum* paulo *viscidius*, vel partibus quibusdam salinis & oleosis imprægnatum, per *tubulos* quosdam *angustiores*, leniori aëris agitatione & quasi suffocatione propellitur, semper illud in *vesiculas* nunc plures, nunc pauciores, in tubulorum illorum extremitatibus expandatur, id quod vel *puerorum* nostrorum *lusu*, aqua *sapone* saturata fieri solito, in vulgus constat.

stat. Quoniam ex anatome vero plantarum constat, partes, fibrasque, illarum solidas maximam partem *tubulos, canaliculosque*, minimos constituere, quæ inde a *radicum* fibrillis ad *extremos* usque *frondium* in plantis perfectioribus *apices* excurrunt; neque minus constat succum nutritium nulla fere *alia* vi, quam *aëris*, radicum fibrillis incumbentis & *gravitate*, & *vi elastica*, ad frondium apices propelli; probabile admodum est, succum nutritium, aëris vi per tubulos plantarum angustissimos, ad illorum usque extremitates propulsum, in *vesiculas* quasdam minimas expandi, postque partium aquearum insensibilem transpirationem *solidescere*, formamque illam vesicularem retinere, sicque primum illud concretum vesiculare, & utriculare, in plantis formari. Atque ex simplicissima hacce theoria omnia fere circa nutritionem, & incrementa, plantarum occurrentia phænomena explicari, illisque, quæ a viro solertissimo, eruditissimoque, STEPHANO HALES, in *the Vegetable Statics*, jam observata sunt, lucem aliqualem affundi adhuc posse existimo, uti alio tempore pluribus ostendam. Hoc ergo modo viridulam quoque illam substantiam, eamque vesicularem, & utricularem, ex minimis reticuli cujuscvis tubulis, illorumque extremitatibus, in *foliis* quasi exsudare, atque minimis illis tubulis adhærescere, ibidemque intra cuticulas sensim paulatimque magis indurari, sicque *cum tubulis* illis, ex quibus protruditur, quorumque lacunis intertextum quasi est, in *utroque* folii cujuscvis *reticulo commune* & *continuum* quoddam *expansum* tandem efficere, admodum mihi est probabile. Quæ *causa* vero *divaricationis* tubulorum ipsorum a se invicem sit, etsi ex ipsdem fundamentis intelligi jam poterat, pluribus tamen explicari jam in præsentī nequit. Quoniam

pulpa

pulpa vero illa *viridis* longe *tenerioris* adhuc, *molliorisque*, quam *ipsi* reticulorum *tubuli* sunt, substantiæ est; *facilius* quoque *putrefactione* eroditur quasi, & destruitur, dum *tubuli* reticulorum *ipsi integri* adhuc, *illæque* a putrefactione ista supersunt, illaque omni ex parte denudati conspici distinctissime possunt.

Hoc ipsum vero, jam *alteram* illam observationem mihi suppeditat, quæ annotatione aliqua adhuc digna esse videtur. Etenim sæpius mihi in *lapidibus figuratis*, qui *plantarum* variarum, etiam exoticarum, figuras referunt, atque ejusmodi quoque plantas, cum omnibus suis ramificationibus expressas, sæpe exhibent, quæ adeo *teneræ*, & *subtiles*, sunt, ut nullæ, illis similes in universo naturæ regno ullibi existant, dubium movit, undenam illarum figuræ oriri in lapidibus istis potuerint. Certe in montibus, *Gottingam* nostram cingentibus, magnâ ejusmodi lapidum copia jam eruitur, & ad construenda ædificia, publica privataque, immo & ad sternendas urbis vias plateasque, adhibetur; quæ præter varii generis *conchylia petrefacta*, tum & *stellas marinas*, *cornua* ita dicta *Ammonis*, & ejusmodi alia, ingentî multitudine sinu ipsorum comprehensa, inter conchyliorum *juncturas*, immo in *ipsis* nonnunquam *conchyliis* petrefactis, adeo affabre factas *subtilissimarum arbuscularum* delineationes exhibent, ut nudo oculo vix adsequi omnia liceat, meritoque dubitandum sit, esse in tota natura nullum ejusmodi plantarum genus, quod subtilissimos adeo ramusculos habeat. Post sceletorum vero illorum præparationem, factamque istam observationem, quod putrefactione *pulpa* illa *viridis facilius*, quam *ipsi reticulorum tubuli*, corrumpatur, dubium fere illud;

mihi subortum, jam expiravit. *Subtilissima* enim illæ in *lapidibus*, vel *corporibus* etiam *petrefactis*, delineatæ *arbusculæ* nihil jam videntur esse aliud, quam ipsa *foliorum* hujus vel illius plantæ, *post putrefactionem* illorum adhuc *residua*, *reticula*, quæ, post reliquorum corruptionem, figuram suam massæ isti molliori, quæ in duriores successu temporis lapidem abiit, impressam, delineatamque reliquerunt ita, ut ipsa non raro in *lapideam* substantiam commutata deprehendantur. Apud me saltem hæc, ob summam reticulorum istorum, cum subtilissimis illis arbusculis, affinitatem, dubitatione omni carent: forsan vero & aliis isthæc non omni probabilitate destitui videbuntur.

XII. *An Account of an Earthquake at Scarborough, on Dec. 29. 1737. communicated in a Letter from Maurice Johnson, Esq; jun. Secr. of the Gentlemens Society at Spalding, to C. Mortimer, M. D. Secr. R. S.*

S I R,

Spalding, Jan. 7. 1737-8.

SINCE I last did myself the Honour of writing to you, nothing, I think, worth communicating to you for the ROYAL SOCIETY, in the philosophical Way, has occurred to us here, until last *Thursday*, when the following Account of an Earthquake, which has very lately happened at *Scarborough*, as sent in a Letter from an Eye-witness, to a Gentleman here,

was

was read, dated thence the 30th of *December* 1737.
in these Words:

—“ The Ends of several Inclosures or Fields
“ behind the Clift, on the Back of the Spaw, sunk
“ down very low into the Ground, making a large
“ Valley of a vast Length, and considerable Breadth,
“ with Five Cows then grazing on it (which they
“ got out this Morning), the Weight of which shook
“ and opened the Hill behind the House, after a
“ frightful Manner, and forced up the Sands an hun-
“ dred Yards in Length on each Side the Space, and
“ Twenty-seven broad, to the Height of Six Yards,
“ and in some Places Ten Yards high.

“ The Pier, intire as it was, moved sideways out
“ of its Place, and rose up about Five Yards in the
“ Air; the House fell down, and at the same time
“ took Fire.

“ The Flag-house, and wooden Rails, which were
“ about the Mouth of the Well, were forced up in
“ the Air above Ten Yards high, so that it is thought
“ the Spaw-water is intirely lost for ever *.

“ The Tide was out when this happened, and I
“ was walking on the Spaw till after 12 o’Clock,
“ when I saw the Sands beginning to rise about half
“ a Foot: There were but few People there then,
“ but in less than Two Hours the Sands were covered
“ with Men, Women and Children, to see the Sands
“ and Pier rise gradually; which they began to do
“ about 12 o’Clock Yesterday Noon, and were at the
“ Height I mention before it was dark, and continues
“ so now.

* N. B. The Spaw was soon after recovered as good as before.

“ Nobody came by any Hurt, the People of the House getting away in Time; but all *Dickey's* * Household-goods are lost, with a Cellar well stocked with Wine and Ale.”—

Now, Sir, though this Representation be not altogether so accurate, in every Part of the Relation, as we could have wished; yet coming from an Eye-witness, and who happened to observe it from the first Motion, and is esteemed a Person of Fidelity, we thought it might not be unacceptable to the ROYAL SOCIETY, and to you, Sir, and which, if the most learned and worthy President judge proper, you may be pleased to communicate to that Learned and Illustrious Body, with our most humble Services. I am,

*Your most obedient,
and obliged humble Servant,*

Maur. Johnson, *jún.*

XIII. *An Examination of Sea-water frozen and melted again, to try what Quantity of Salt is contained in such Ice, made in Hudson's Streights by Capt. Christopher Middleton, F. R. S. at the Request of C. Mortimer, R. S. Secr.*

DR. Hales, in his learned Paper lately read at the ROYAL SOCIETY, wherein he proposes a Method of rendering Sea-water fresh, and wholesome

* *Richard Dickinson.*

to drink, mentions a Diversity of Saltneſs of the Water at the *Nore* in the Mouth of the *Thames*, and the Water taken up in the *Mediterranean Sea*, this containing $\frac{1}{27}$ of Salt, the former $\frac{1}{29}$. Mr. *Boyle*, in his Observations of the Saltneſs of the Sea, p. 4. ſaith, that about *Holland* the Salt in the Sea-water hath been found to be $\frac{1}{40}$. In the *Engliſh Chanel*, p. 31. he found Sea-water $\frac{1}{45}$ heavier than Conduit-water; and, by immerſing a Lump of Sulphur in it, he found the Difference $\frac{1}{53}$; but by Diſtillation *ad ſiccitatem*, p. 33. he found the Salt to be $\frac{1}{30}$, and in another Trial $\frac{1}{37}$. It is certain the Sea differs in Saltneſs in different Parts: It is, in general, obſerved, that in hotteſt Climates the Water is the ſaltreſt. At *Mofambique* Mr. *Boyle*, *ib.* p. 29. relates an Inſtance of a Ship drawing Two Handsbreadth leſs Water than uſual. On the contrary, when Salt-water Freezes, it hath been thought to let fall all its Salt; the Ice of Sea-water, and the Water melted from it, taſting freſh, and being good for boiling Meat and Peaſe in: Capt. *Middleton*, being in *Hudſon's Streights* in July 1738. took Ice from under the Surface of the Sea, which he melted till he got 40 Quarts of Water, which he evaporated to Dryneſs, and out of that Quantity had only Six Ounces of Salt, or about $\frac{1}{11}$.

XIV. *A Rule for finding the meridional Parts to any Spheroid, with the same Exactness as in a Sphere, by Colin Mac Laurin, F. R. S. Communicated by Andrew Mitchel, Esq; F. R. S.*

IT was demonstrated long ago, that in a Sphere the Nautical Meridian Line is a Scale of logarithmic Tangents of the half Complements of the Latitudes. The same may be computed with no less Exactness to any Spheroid by the following Rule.

Let the Semidiameter of the Equator be to the Distance of the *Focus* of the generating Ellipse from the Centre as m to 1. Let A represent the Latitude for which the meridional Parts are required, s the Sine of this Latitude, the *Radius* being Unit; find the Ark B , whose Sine is $\frac{s}{m}$; take the logarithmic Tangent of half the Complement of B from the common Tables; subtract this logarithmic Tangent from 10.000000, or the logarithmic Tangent of 45° ; multiply the Remainder by $\frac{.7915.7044678978}{m}$, &c. and the Product subtracted from the meridional Parts in the Sphere, computed in the usual manner for the Latitude A , will give the meridional Parts expressed in Minutes for the same Latitude in the Spheroid, provided it is oblate. When the Spheroid is oblong, the Difference of the meridional Parts in the Sphere and Spheroid for the same Latitude, is then determined

mined by a circular Ark ; but it is not necessary to describe this Case at present.

Example: If $m m : 1 :: 1000 : 22$. then the greatest Difference of the meridional Parts in the Sphere and Spheroid is 76.0929 Minutes: In other Cases it is found by multiplying the Remainder above-mentioned by 1174.078.

XV. *The parabolic Orbit for the Comet of 1739. observed by Signor Eustachio Zanotti at Bologna.*

THE Motion in its own proper Orbit was retrograde.

The *Perihelion* was in . . . 5. 11.

The descending Node in . . . 25. 18.

The *Perihelion* from the Node 69. 53.

The Comet was in the *Perihelion* June 9. 9. 59.
in the desc. Node July 18. 4. 57.

The *Perihelion* of the Comet's Orbit was within the Sphere of the Orbit of *Venus*, and without that of the Orbit of *Mercury*; being distant from the Sun 0,69614 Parts of the Earth's mean Distance from the Sun.

The Plane of the Orbit stood inclined to the Plane of the Ecliptic in an Angle of $53^{\circ}. 25'$.

The Diurnal mean Motion, according as it is interpreted by Dr. *Halley* in his Elements of cometical Astronomy, was $1^{\circ}, 5707$.

XVI. *A Letter from the Right Revd Father in God Robert Lord Bishop of Corke, to the Right Honble John Earl of Egmont, F.R.S. concerning an Extraordinary Skeleton, and of a Man who gave Suck to a Child.*

My Lord,

Corke, Aug. 8. 1738.

AS I am just come from seeing a most extraordinary natural Curiosity, I cannot forbear letting your Lordship partake with me in the Amusement.

It is the Skeleton of a Man, whose Bones, during his Life-time, were almost all grown into one intire Bone, [see TAB. V. Fig. 1. 2.] so that now his Flesh is taken from them, he is, without further Trouble, one intire Skeleton. The only Bones he could move before his Death, were the Wrist of his Right Hand, and the Bones of his Knees, so that he could move his Legs a little; and, when set upright, could in about a Quarter of an Hour get a Foot forward.

For many Years before his Death, he could not alter his Posture in the least. His Name was *William Clarke*. He was maintained till his Death by one Mr. *Aldworth* in this County. He was valued by his Master on account of his Honesty. The only Use he was capable of being put to, was that of watching the Workmen; for, when he was once fixed in his Station, it was impossible for him to desert it.

At about 18 Years of Age he began to be unwieldy, and so continued growing more stiff, till he lost all Use of his Limbs, and died in the 61st Year
of

of his Age. The Posture into which he fixed at last, is somewhat like that of the *Venus* of *Medicis*, only that his Right Hand is the lowest, and the Left Hand does not rise higher than the Elbow of the Right. He was originally deformed, his Left Shoulder rising higher than his Right; the *Vertebrae* of his Back are exceedingly bent inwards towards the lower Part, with an Inclination towards the Left Hip. The *Os Sacrum* is so bent outwards, that you have no Sight of it at all as you view the Skeleton in Front. His Left Knee does not come down so low as the Right by Three or Four Inches. There is hardly one Bone in his Body in the Figure it ought naturally to be, except the Bones of his Legs, which are not much distorted.

He is one intire Bone from the Top of his Head to his Knees. I shall endeavour to give your Lordship some Account of it, because I think it one of the most extraordinary things I ever saw, though it will be very difficult for me to do it, it being so many Years since I have seen any thing of Anatomy, and of Consequence have forgotten the Names of the Bones belonging to the various Parts of the human Body.

His Head seems regular, and the Sutures pretty distinct, though more united than in common Skulls. His Jaw-bones seem intirely fixed and grown together, as are also the Teeth in the hind Part of the Jaw. His fore Teeth are very irregular, which left a Vacancy for him to suck in his Food at. Out of the Back of his Head there grows a Bone, which shoots down towards his Back, and passes by the *Vertebrae* of the Neck at about an Inch Distance:

This Bone unites to the *Vertebræ* of the Back, and the *Scapula* of the Left Shoulder, from whence it disengages itself again, and continues distinct, till it divides into Two towards the Small of the Back, and fixes itself into both the Hip-bones behind. The *Vertebræ* of the Neck and Back are one continued Bone.

In the fleshy Part of his Thighs and Buttocks Nature seems to have sported herself, in sending out various Ramifications of Bones from his *Coxendix* and Thigh-bones, not unlike the Shoots of white Coral, but infinitely more irregular; some behind, and some before; some in Clumps and Clusters, and others in irregular Shoots of Eight or Nine Inches in Length. You cannot pass your Hand between his Two Knees, which incline much towards the Right, his Left Shoulder having been the highest. One of the Bones of his Left Arm was once broken by a Fall, and Nature has shot out another Bone a little above the bending of the Arm, which unites to the broken Bone, and makes it much stronger than it was before, though the Bone seems more liable to decay about the Place where it was formerly broken. All the Cartilages of his Breast, Four only excepted, were turned to Bone. These Four served to move his Breast in Respiration.

Out of his Heels there frequently grew Bones like the Spurs of a Cock, Two or Three Inches long, which he shed as a Deer does his Horns. When he was dissected, there was a Bone found in the fleshy Part of his Arm, quite distinct and disengaged from any other Bone; it is very thin, about Four Inches long, and the Fourth-part of an Inch broad, with
fe-

several Ramifications. What is very odd, is, that while these Bones were growing, he never complained of any Pain in his Muscles.

This Skeleton belongs to Dr. *Barry*, an ingenious Physician in this Town, whom I intend to persuade to publish a Treatise about it, and to get Three or Four Copper Plates taken from the different Views of it.

And now that I am engaged in writing, I will venture to give an Account of a Man that I met at *Inishanan*, about 10 Miles from this Place. He was an old Man about 70 Years of Age, by Birth a *Frenchman*, but was a Refugee on account of his Religion, was bred a Gardener, and, by all Accounts, had been industrious, till deprived of his Strength by Age.

He asked me for Charity, and I gave him half a Crown. I mention this Particular, that the remaining Part of the Story may not seem to be told for the sake of Gain. After I had done this, and was gone into the House, I heard a Noise at the Door: The Man, out of Gratitude, had returned to shew me a Curiosity, which was that of his Breasts, with which he affirmed he had once suckled a Child of his own: His Wife, he said, died when the Child was about Two Months old: The Child crying exceedingly while it was in Bed with him, he gave it his Breast to suck, only with an Expectation to keep it quiet; but, behold, he found that the Child in time extracted Milk; and he affirmed, that he had Milk enough afterwards to rear the Child. I looked at his Breasts, which were then very large for a Man; but the Nipple was as large or larger than any Woman's I

ever saw. Some Ladies were then passing by; so I sent him off in Haste, and have not seen him since.

I have either heard or read of one Instance of this kind before.

I shall make no Apology for giving you the Trouble of this long Letter, but that of assuring you that I am with great Sincerity

*Your Lordship's
most obedient,
humble Servant,*

ROBERT CORKE.

XVII. *Extracts of Two Letters from the Rev'd Dean Copping, F. R. S. to the President, concerning the Cæsarion Operation performed by an ignorant Butcher; and concerning the extraordinary Skeleton mentioned in the foregoing Article.*

S I R, Dublin, March 16. 1737-8.

I Have transcribed a Case, which I received from a young Clergyman, who some time studied Physic, and knows the Woman: I shall probably see her at *Clogher*, where she now lives. The Case happened within these Two Years, but I cannot learn the exact Date at present.

Sarah Mc Kinna, who now lives at *Brentram*, Two Miles from the City of *Clogher*, in the County
of

of *Tyrone*, was married at the Age of Sixteen Years. — Before her Marriage she never had the Appearance peculiar to Women ; but, in a Month after her Marriage, those Appearances shewed themselves properly. Ten Months after her Marriage, she found the Symptoms of Pregnancy, and bore a Child at the Expiration of the usual Time. Ten Months after, she was delivered of another ; and each time had a speedy and easy Delivery.

Two Months after her second Lying-in, Symptoms of Pregnancy appeared again, and increased in Proportion to the Time ; but at the End of Nine Months those Symptoms began to dwindle, and in a little time she had no other Reason for thinking she was with Child, but an absolute Stoppage of her *Catamenia* : Nor had she, during the Space of Six Years and some Months, any one Return of them ; but for the greatest Part of that Time, especially the Four first Years, she was perpetually afflicted with most violent Pains in the middle Region of the *Abdomen*.

Some time in the Seventh Year after her last Pregnancy, which ended in such an unusual Manner, a Swelling in her Belly, and other Symptoms, made her conclude she was again pregnant.

About Seven Months after this uncertain Account, a Boil, as she thought, appeared about an Inch and an half higher than her Navel.

During this time of her Pregnancy she often found the Symptoms of her being quick with Child, till about Six Weeks before this Boil (as she calls it) appeared. It was attended with very great Pain.

She sent for one *Turlogh* [*Terence*] *O Neill*, a Butcher, who then did, and does now live with Capt.

George

George Gledstanes, about a Mile from *Clogher*. This Man came to her the *Sunday* after her Message, and found her in an expiring Condition. By this time, the Impostumation (which she apprehended to be a Boil) had broken, and an Elbow of the Child had forced itself through it, and appeared in View. At the Request of herself and Friends, he undertook to administer Relief to her, and made so large an Incision above and below the Navel, as enabled him, by fixing his Fingers under the Jaw of the *Fœtus*, to extract it; in which Operation he met not with the least Impediment. He afterwards looked into her Belly, and seeing something black, he put in his Hand, and extracted, by Pieces, a perfect Skeleton of a Child, and several Pieces of black putrefied Flesh. After the Operation, he swathed her up; and in Six Weeks she pursued her domestic Business.

She has been in good Health ever since this wonderful Accident happened; only she has a Navel-rupture, owing to the Ignorance of the Man in not applying a proper Bandage. I am, &c.

J. Copping.

Clogher (Ireland) June 2. 1738.

— I Have seen the Woman, of whom I sent you the surprizing Account, with her Husband, and inquired more particularly into the Fact; but hope to be still a little more particular, when I see the Man who extracted the Child. They are so ignorant, that, with their bad Language, I could not make myself quite Master of what they said; but, if they speak true, there is something more surprizing than the former

former Account mentioned: For the several Parts of the latter, or rather the former, *Fætus*, were extracting by Degrees, from *July* to *Christmas*.

She had, by their Account, been married about Eight or Ten Years before her first Pregnancy.

As well as I could apprehend them, she had a Midwife at the proper Time, in her first Pregnancy, for Eight Days, Day and Night: When the Symptoms disappeared, the Swelling decreased, and People concluded there was no Child.

This Child was carried for Seven Years, till she had been again pregnant for Nine Months; about which time there was a Swelling in her Navel about the Bigness of a Goose-egg, which broke in a small Orifice, of itself, and discharged a watry Humour.

She had a Midwife, and Three or Four Physicians, who gave her over, and left her as a dying Woman. From this Orifice started the Elbow of a Child, which hung some Days by the Skin, visible to abundance: At length she cut it off for her own Relief.

When *O Neile* came, (whom I have not yet seen, but shall soon) she begged him to help her. The Man was frightened, and went to sleep; but, when he got up, gave her a large Draught of Sack, and, I suppose, took one himself; when he opened the Place, and made such a Hole as the Man describes to be as large as his Hat. He put in his Hand, took hold of the Second Bone of the Child, and, pulling it backward and forward to loosen it, in a little time extracted the Child. After this, looking into the Hole, and seeing something black, he put in his Hand, and extracted other Bones. Some Bones still remained, which, as I said; were extracted at different times, it
seems

seems too in different ways; for some came by the Navel, others from the Womb the natural Way. She had great Pain at each time.

The former Account says, she pursued her domestic Business: She might be about the House, but she was 15 Months confined to the House. I have examined the Rupture, and can put a Finger a pretty Way up into the Body. Mr. *Dobbs*, I hear, an eminent Surgeon at *Dublin*, thinks there may be Relief, and that the Rupture may be much helped, and the Guts reduced. I question whether he will think so, when he sees her. However, I have collected about Four Pounds for her among the Gentlemen that visit my Lord Bishop, shall buy her some Cloaths, and send her to *Dublin* about 10 Days hence, to the Infirmary. She was fond of going, but her ignorant Priest, and some other ignorant Neighbours, told her they would keep her till she dies: But, upon my answering those Difficulties, she consents to go; her Husband will carry her; and they are so thankful to me for entering so much into their Condition, that they now say she shall go to *London*, or where-ever I please. I am sorry the several Bones extracted were carried away by different Physicians, that I cannot procure one to be sent to you; which, with the Account, might find a Place in your surprising Collection.

I have wrote so long a Letter, that, by way of Apology, and to make some Amends, I must make it still longer by another Account, which a worthy Clergyman gave me by Strength of Memory, from the Letter of a Physician to him.

William

William Clark, a poor Man of the County of *Corke*, about 18 Years of Age, complained of a Stiffness in his Joints, which by Degrees increased till it came to an univerfal *Anchylosis*: That is, all his Joints were immoveable or ossified. He lived in this Condition 38 Years, and Dr. *Barry*, the Physician at *Corke*, has made a Skeleton of him; and his Account of it is this [see TAB. V. Fig. 1. 2.]: Not one Bone in his Body has the natural Form; for all his Joints are immoveable and ossified: And such a luxuriant Disposition had all the Humours of his Body to turn into Bone, that many little Branches of Bone-like Coral, spring from the Joints and several Parts of the Body. The whole Spine is ossified, and one intire Arch of Bone there is from the *Occiput* down to the *Os Sacrum*; out of which arises a very protuberant Bone, which serves as a fine Handle to the Skeleton. A sharp Horn, like a Cock's Spur, grew out of his Heel every Year. The Extract concludes thus: "It is as difficult to give a particular and exact Description of this curious *Memento mori*, as of *Calypso's Grotto*." I am promised very soon a complete History of his Life, and I shall endeavour to transmit *William Clark's* Name to future Ages.

Signed,

John Copping.

TAB. V.

Fig. 1. *The Front of the Skeleton.*

2. *The Back-side of it.*

XVIII. *Part of a Letter from Mrs. ———
to Sir John Shadwell, Knt. M. D. Fellow
of the Royal College of Physicians, London,
concerning the extraordinary Skeleton men-
tioned in the Two preceding Papers.*

—THE Man died in the County of *Corke*, 20 Miles from that City: When I was there, he was Steward to Mr. *Allworth*, his Name *Clark*; the Account I am going to give, I had from the Lady he lived with. Twenty Years before he died, he got a violent Fever, by being very warm, and sleeping on the Grass, most Part of a Night. After he recovered from that Disorder, he was never free from great Pains in his Bones, and in Four Years lost the Use of all his Limbs, even the moving his Jaws, that they were obliged to take out many of his Teeth, in the Front of his Mouth, to give him Sustenance, Spoon-meats, and Ale, on which he lived 16 Years: In those Years he could neither sit or lie down, but slept in a Sentry-box, with a small Board which ran in a Groove, and against that he leaned his Stomach: He could never move his Head, by a Bone that grew from his Skull to his Back-bone. I wrote you before, that he slept in the Box, but should have let you know, he did not live in it; for whenever the Weather would permit, he got into the Air: He could move himself on even Ground, with a little kind of Jump, and stand many Hours in the Garden, leaning his Back against a Tree, or Wall: They think his moving with
that

that Motion, and being so much in the Air, kept him alive so long. The Picture * [see TAB. V. Fig. 1. 2.] is within Four Inches in Length and Breadth of the Bones. It is done by a very good Hand, and very exact; and every thing I have wrote to be depended on; and taken from the Bones; it is not a Copy. I was in Haste: Mr. *Vandenkagen*, who drew it, finished mine, and died suddenly, before he had quite done.

XIX. *A Narrative of a new Invention of expanding Fluids, by their being conveyed into certain ignified Vessels, where they are immediately rarefied into an elastic impelling Force, sufficient to give Motion to Hydraulopneumatical and other Engines, for raising Water, and other Uses, &c. by John Payne.*

TO produce a great Power at a small Expence, is what every body desires in moving Machinery; and is what, by this new Invention, we have proved by Experiments and Practice to be a great Improvement, when applied to that noble Invention the *Fire-engine*: Therefore I shall proceed to give a short Description of the Vessels and Machinery contrived for that Purpose; *viz.*

A Pot or Vessel made of wrought or cast Iron, nearly the Figure of a Cone, whose Diameter at the

* Now in the *Museum* of Sir Hans Sloane.

Base is Four Feet, with Holes round the Edge, for Nails or Screws to fasten a globular Head of Copper of about Five Feet and half Diameter, as by the Figure annext will appear [TAB. VI. Fig. 2]. There is then placed in the Inside a small Vessel or Machine, which I call a Disperfer: This Bafon or Vessel hath Spouts round the Sides fixed to it, and the Bottom thereof resteth on a Centre-pin; and in the Middle of this Bafon or Vessel is a Socket, with Holes near the Bottom, to let the Water or Fluids pass from above, through an iron Pipe of about Seven Feet long, the lower End of which is placed in the Socket, so as the End of the Pipe will be always immerged in Water in the Bafon, to prevent the expanded Fluids from returning up the Pipe; and the other End of this Pipe goes up through the Copper-head, which is inclosed very tight, but so as it may easily be moved with a circular Motion, in order that the Water or other Fluid, which is conveyed through this iron Pipe down into the Disperfer, may be dispersed or showered round, on the Sides of the red-hot Pan, or ignified Vessel, in a very exact manner.

This evaporating Vessel being thus completed, we then take One, Two, or more, of these Vessels, with these Contingencies, and place it or them in a reverberatory Arch or Canal, for conveying the intense Heat of a strong Fire, the Flame of which encompasses the metal Pot or Pots, and brings them to a red Heat; and in that Condition they are continually kept, while in Use, with the Water running from a Cistern or Vessel (where the Water is heated) through a Gauge-cock down the iron Pipe into the Disperfer, which conveys it to the Sides of the ignified Vessel or Pot,

Pot, when it is immediately rarefied or expanded into an elastic Steam or Vapour, fit for Application to give Motion to fundry sorts of Machinery, &c.

TAB. VI. Fig. 1.

1st, A, *A Globe made of Copper, 12 Inches Diameter.*

B, B, *Two brass Cocks, one opposite to the other, fitted very tight.*

C, *A Handle or Bale, fastened to the Globe, by which it may be hung or held up.*

D, *A small Valve or Clack, fitted to the upper Cock, of One Inch Diameter.*

The Whole, thus fitted, weighed 15 Pounds 3 Ounces Troy, or 12 Pounds 9 Ounces $\frac{1}{2}$ *Avoirdupois*; and, filled with Water, it weighed 45 Pounds 7 Ounces, from which deduct the Metal, the Weight of Water is 32 Pounds 13 Ounces $\frac{1}{2}$ *Avoirdupois*, which is about 4 Gallons, containing about 925 cubical Inches.

This Vessel or Globe I then hung over the large Vessel F, in which Water was rarefied or converted into Steam; and by the Pipe E, at the large Cock G, which being open, as also the other Cocks B B, the Steam had a free Passage through the Globe A, by which the Steam excluded or forced out the Air that was in the Globe, and by its elastic Quality supplied its Place; when both Cocks B B were suddenly shut, and the Globe A taken down and hung over a Vessel of cold Water, with the lower Cock B, immersed in Water, and then opened under Water; on which the Water rushed into the Globe very furiously, until
it

it had supplied the *Vacuum*, when the Cock was again shut, and the Globe, with the Water, put in the Scales, and then found to weigh 44 Pounds 9 Ounces; which, take from 45 Pounds 7 Ounces, the whole Weight, as before, there remains but 14 Ounces, the Difference, which sheweth that all the Air was nearly excluded out of the Globe by the Steam: In Ounces it stands thus $\frac{727}{713}$, which is very near a perfect *Vacuum*.

2dly, I again excluded the Air out of the Globe with Steam as before, and both Cocks BB being closed with the Globe full of Steam, we put the Globe in the Scales, and it weighed 12 Pounds 10 Ounces $\frac{1}{2}$. I then opened one of the Cocks, and let in the Air, on which the Scale descended; and, by adding Weight in the other Scale, it was found to weigh 12 Pounds 11 Ounces; which shewed that the Weight (not the Pressure) of the Air the Globe contained, was $\frac{1}{2}$ an Ounce *Avoirdupois*.

3dly, The Globe being filled with Steam, as before, and condensed with cold Water on the Outside of the Globe, and the Metal again made very dry, and the Air let into the Globe, the Water from the condensed Steam was found to weigh 4 Penny-weight.

4thly, The Globe filled with Steam, as before; only now I continued the Globe longer with the Steam passing through it, by which it acquired a greater Degree of Heat; for I found by those Experiments, that the least Degree of Cold less than the Steam, a Part would be condensed again into Water, by which the Quantity could not be certainly attained to, that would exclude the Air out of a certain Space, which is the chief End of this Experiment. But in this Experiment I succeeded better; for, on weighing the

the Globe, when the Steam was condensed, the Air let in, and all cold, it was as followeth; *viz.* 15 Pounds 3 Ounces 2 Penny-weights *Troy*, the Weight without the Steam being 15 Pounds 3 Ounces; so that the Weight of the Water condensed from the Steam, or the Water converted into a strong elastic Steam to fill the Space of this little Globe, is but 2 Penny-weights, or $\frac{1}{10}$ of an Ounce *Troy* of Water, by which $\frac{1}{10}$ of an Ounce *Troy* of Water fills, when converted into Steam, 925 cubical Inches of Space in a Vessel, so as to exclude nearly all the Air. I repeated this Experiment several times, and found it nearly the same; and by immersing the Cock in Water, and opening it again, as in the first Experiment, I found the Weight of Water to be nearly as above, and to make about $\frac{11}{16}$ Void or *Vacuum*; so that 1 Ounce *Troy* of Water makes 9250 cube Inches of Steam, of equal Force with the like Number of Inches of Air; and with this Remark, that the Weight of the Steam is much less than the Weight of common Air; for in this Globe I found the Air to weigh $\frac{1}{2}$ Ounce *Avoirdupois* or 9 Penny-weight *Troy*; and the Steam, which filled the same Space, to weigh but 2 Penny-weight *Troy*, which is but little more than $\frac{1}{7}$ th Part, and shews how very small the Particles of Water are when so divided by the Force of Fire, and of what Force. From which I shall conclude, that 1 cubic Inch of Water will discharge or force out 4000 Inches of Air from a Vessel of that Content, which I have likewise proved by other Experiments in working the Fire-engine: Therefore I shall make it my Standard in some future Calculations for Practice, about that noble Machine.

5thly, I proceeded, as before, with Steam in the Globe A; and condensed it, as in the third Experiment; and then tried the Pressure of the Atmosphere on the Clack or Valve D, and found it required about 10 lb *Troy*, to lift the Clack from its Tube of 1 Inch Diameter; but in this I was not exact with small Weights.

6thly, I excluded the Air with the Steam, and in Place of the Clack I screwed on very tight a Plate, on which I placed a glass Receiver, as usual, with the Air-pump; and then, turning the Cock, the Air under the glass Receiver expanded itself into the Globe, by which I had equally a Share of the *Vacuum* partly made in the Globe, and could thereby make many Experiments that are made with the Air-pump, &c. which I mention only, that some curious Gentlemen may hereafter make some further Observations by the like Experiments.

Observations from Experiments made by J. Payne.

1. **T**HAT a Pot or Vessel, of the Size and Shape here mentioned, will (being kept to a dark-red Heat, and the Water regularly dispersed) rarefy or expand 50 Gallons of Water, Wine Measure, *per* Hour.

2. That a cube Inch of Water will make in Practice 4000 Inches of Steam; or that the elastic Steam of one cube Inch of Water is sufficient to exclude the Air out of a Vessel that is in Content 4000 Inches.

3. That the above 50 Gallons will produce 46,000,000 cube Inches of elastic Steam *per* Hour, which is *per* Minute 770,000.

4. That

4. That the second Pot or Vessel, as in the Draught TAB. VI. Fig. 2. will rarefy or expand 40 Gallons of Water, Wine Measure, *per Hour*, and will produce 36,960,000 cube Inches of elastic Steam *per Hour*, which is *per Minute* 616,000 Inches.

5. That both being united together make 1,386,000 cube Inches of Steam every Minute, from 346 Inches of Water.

6. That, by an Experiment made at a Fire-engine, 40 Gallons of Water *per Hour*, made into elastic Steam in this Method, will effectually give Motion to a 24 Inch Cylinder *Fire-engine*.

7. That, by true Experiments made at *Wedgbury* and *Newcastle on Tyne*, One hundred Weight, containing 112 lb of Pit-coals, will, and is sufficient in this Method to expand or rarefy 90 Gallons of Water *per Hour* into an elastic Steam or Vapour.

8. That, by the best Accounts and Observations I could get and make, they consume under their Boilers to make the same Quantity of Steam, Three hundred Weight of Pit-coal, at 112 lb to the Hundred, in working a Fire-engine one Hour.

9. That 95 Gallons of Water *per Hour*, expanded or rarefied into Steam, will work a 36 Inch Cylinder Engine.

10. From these Observations I conclude, that this new Invention will save at least 60 *per Cent.* in Pit-coals, to work a Fire-engine.

TAB. VI. Fig 1.

A, A, *The Two Pots.*

B, B, *The Two Copper Heads or Globes.*

5 P

C, C,

- C, C, *The Two sinking Pipes, for waste Water, that is not evaporated.*
 D, D, *Clacks or Valves, to keep out the Air.*
 E, E, *The Two Dispersers and Spouts.*
 F, F, *The Stools with a Centre-pin, on which the Disperser resteth.*
 G, G, *The Two iron Pipes, in which the Water is conveyed to the Cistern.*
 H, *A Cistern of hot Water.*
 I, I, *Two Cog-wheels, to turn the Disperser.*
 K, *A Steam-pipe, in which is conveyed the Steam to the Cylinder.*
 L, *The Cylinder of the Fire-engine.*
 M, M, *Leaden Pipes, that convey hot Water from the Cistern to the Disperser.*

XX. *An Examination of Westashton Well-waters, belonging to Tho. Beach, Esq; a Well about Four Miles from that of Holt; by Ambrose Godfrey Hankewitz.*

Obs. 1. **I** Took four Ounces of the *Westashton* Water, with as much Milk, and set them on the Fire; as soon as they boiled, the Milk began to curdle, which denotes a brackish Salt of a neuter Nature. The Water changes Syrup of Violets green.

Obs. 2. Some Powder of Galls infused in this Water, gives it a Tinge of a brown Purple; by which it appears, that this Water is Chalybeate: For all Martial Waters will, with Galls, turn blackish or inky.

Obs. 3.

Obs. 3. A fixt *Alkali*, as *Ol. Tartar. per deliq.* and a volatile one, as *Sp. Sal. Armoniaci*, caused a white Precipitation, which denotes an aluminous cretaceous Earth.

Obs. 4. A Solution of Salt of Lead, causes a Cream-like, or a troubled milky Colour.

Obs. 5. The usual acid Spirits, *viz.* Spirit of Salt, Nitre, and Vitriol, cause no Alteration; which shews that the Water is itself impregnated with an Acid.

Obs. 6. The Water, being evaporated to a Pellicule, deposits saline Crystals of a rough or austere Taste, being of a styptic Nature; and separates a Martial yellowish Okre (which is attracted by the Loadstone), and is an Absorbent, for it ferments with Acids. The remaining Brine, being evaporated to Dryness, leaves a Salt of a lixivious alkaline Taste.

Obs. 7. Some of these Salts being put into Water, Three Parts out of Four dissolve very readily; but One-fourth Part will not dissolve at all, but is of a Talcky Nature, and unalterable in the Fire.

Hence we may observe, that Chalybeat Waters, as long as they retain their natural sulphureous *Gas* are capable of keeping suspended, or floating in them, these Talcky Substances; but that Boiling drives away that sulphureous *Gas*, upon which this Talcky Substance subsides, and cannot again be dissolved in Water, and remains fixt against the Power of the Fire; for it suffers no Alteration upon a red-hot Iron, neither emitting Flame, nor melting, as neither doth Talck itself.

Obs. 8. These Chalybeat-waters contain somewhat of the same Nature as our Cathartic *Epsom-salt*, only not so mild upon the Tongue; for by this Examen,

when their *Gas* is gone, they are found to contain two Sorts of such-like Earths; the one absorbent, fermenting with Acids; and the other fixt, or Talcky: And that this Substance is really Talcky, is confirmed by the digging up of a pretty deal of Talc in the sinking this Well.

All the Salts of the medical Waters are more generally alkaline than acid, being of a Martial Nature, impregnated with Sulphur, which gives them a muriatic Taste.

We may hence conclude, that this *Westashton* Water is a very good Chalybeate Water; and, by Report, more plentiful and more constant all the Year-round, than the Well at *Holt*, which Spring diminishes much at a certain time of the Year; but both seem alike for their Virtues, and physical Use, being both alike Martial.

XXI. *An Examination of the Chilternham Mineral Water, by Conradus-Hieronimus Senckenberg; which may serve as a Method in general for examining Mineral Waters.*

THE Water is bright and clear to the Sight, of no Smell, yet of a bitter Taste.

To know its constituent Parts, the following Experiments were made; and, first, to try whether there is any *alkaline Salt* in it.

Rhenish Wine was mixt with the Mineral Water. *Rhenish Wine* is a subtilized *Acidum essentiale* in a spirituous and oily Liquor: Wherefore an *alkaline Salt* should have been manifested; but it was unaltered.

Di-

Distilled Vinegar is a stronger vegetable Acid ; but, mixt with the Water, procures no Alteration.

Spiritus Salis, Nitri, and Vitrioli, the three strongest and purest mineral Acids, being mixt with the Mineral Water, there was no Change or Precipitation.

Mercurius sublimatus corrosivus, is a Dissolution of Quicksilver in concentrated Spirit of Salt, which, being dissolved in common distilled Water, manifested not only the volatile, but also the fixed alkaline Salt, in any Liquor, insomuch that it precipitates the *Volatiles* to a *white*, and the *fixed* alkaline Salts to a *red* Powder ; but, mixt with this Water, produced no Precipitation.

Vitriolum Martis is an acid Salt, intimately mixt with Iron-earth : Being dissolved, and put into another Liquor, it will presently betray the alkaline Salts by precipitating them ; but should it find no contrary Salt, then somewhat of the Iron-earth will settle to the Bottom ; as is common in dissolving all sorts of *Copperas* : And so it happened by mixing this Mineral Water with it, when a brown Powder settled, which is the *Terra Martialis*.

All these Experiments shew evidently, that no *alkaline Salt* is in the said Mineral Water.

For, to try whether there is any acid Salt to be found in this Water, the following Mixtures were made :

Aqua Calcis Vivæ, which contains an Earth impregnated with *alkaline Salt*, makes a very quick Discovery of an *Acid*, by Precipitation ; but, mixt with this Water, caused no Variation.

Syrupus Violarum, having a very sensible vegetable Tincture, which, by mixing it with a small Quantity
of

of any *Acid*, turns *red*, and, with an *alkaline* Salt, *green*; but, mixt with this Water, keeps its Colour.

Oleum Tartari per Deliquium, which is an *alkaline* Salt, dissolved in Water: And,

Spiritus Salis Armoniaci, a volatile *alkaline* Salt in Water, they being mixt with this Mineral Water, the Mixture grew milky, and a little after a white Precipitate settled. This happens when a fixed or a volatile alkaline Salt meets with a neutral Salt; then they join together, and somewhat of the alkaline Earth falls down.

Milk mixt with a Mineral Water, and boiled in equal Proportion, will make a Separation, by meeting with either an *acid* or *alkaline* Salt in it, or, by finding of the last Salt, the Mixture will change red; but our Mineral Water may be boiled with it in several Proportions, without any Change or Precipitation.

According to these Experiments, there is no *acid* Salt in this Water.

To see whether there is no *Iron* or *Copperas* in it,

If the *Solution* of *Galls* is mixt with any Liquor, and grows black, then it is a Sign of *Iron* or *Copperas*; but our Mineral Water, mixt with it, turned a little brownish, because of the Salt in the Water.

To know whether there is any *Brimstone* in a Mineral Water, it is to be inquired with a polished Piece of Silver, which, being put in the Water, will turn black or yellowish; but this did not happen with this Water.

To find out the *acidum salinum* in a Mineral Water, you must mix with it *Solutio Argenti*, which turns instantly *white*, and a light Precipitate falls, being the *Luna Cornea*.

A Solution of *Saccharum Saturni*, mixt with the Water, yields the *Magisterium Saturni*.

All the above-mentioned Experiments certify, that our Mineral Water contains no *alkaline* nor *acid Salt*, no *Iron*, *Copperas*, or *Brimstone*: Therefore from the same Experiments it is evident, that the *Chiltenham* Water consists of a *Sal medium fixum vel neutrum*, and a dissolvable *Terra alcalina vel cretacea*, which may be separated.

By a *Sal medium*, is to be understood, a Salt being neither of an *alkaline* nor an *acid* Nature; and that will not precipitate any Solution made with such Salts, nor, mixt with the Syrup of Violets, will change its Colour.

These neutral Salts have always their Origin from an *alkaline* and an *acid Salt*; and, according to the *alkaline Salt* they meet with, so they are qualified. So we have the *Tartarus vitriolatus*, consisting of the *Sal alcali fixum*, and *Acidum vitriolicum*.

The *Arcanum duplicatum* of the *Sal alcali*, Salt-petre, and *Acidum vitriolicum*.

The *Sal Mirabile* GLAUBERI, consisting of common Salt, and its *Terra fluxilis*, and an *Acidum vitriolicum*; but with this Difference, that the *Sal Mirabile* will soon melt in a Crucible with a gentle Fire; but *Tartarus vitriolatus*, *Arcanum duplicatum*, &c. will not melt, even with the strongest Heat, because of the Difference of the Earth in the alkaline Salt, which in the common alkaline Salt is very fixt, but in the common Salt very volatile and fusible.

Such a *Sal medium* as the *Sal mirabile*, we find in this Mineral Water, yet mixt with some common Salt.

As for the Bitterness of this Water, there is no other Reason for it than the *Terra Cretacea*, which is proved
by

by the *Epsom* Salt, where the *Terra alcalina Salis communis*, joined with the *Acidum vitriolicum*; and after the same manner in the *Salmirabile*, the alkaline Earth causes the bitter Taste. The same may also be found, by mixing Quick-lime with Spirit of Vitriol, and it will produce a very bitter Taste; but the Mixture of Quick-lime with Spirit of Nitre causes a Bitterness which exceeds Gall.

One Pound *Troy* of this Water yields 29 Grains of the said *Sal medium*, and 3 Grains of the Earth.

Remarks by C. M.

The Right Honourable the Lord *Cadogan* had communicated a short Account of these Waters to the *Royal Society* on April 17. 1735. being a Letter his *Lordship* had received from Mr. *Tho. Dundas*, Surgeon to his Lordship's Regiment, dated at *Gloucester*, March 25. 1735. wherein he gives an Account of some few Experiments he had made on these Waters, which mostly agree with the preceding ones; as that there were no Marks of a Chalybeate Nature in them; nor any Signs of Nitre or Sulphur: But that six Quarts of this Water being distilled very carefully, the Sediment at the Bottom of the Vessel was nothing more than *Alum* and *Sal Gem*, to which it owes its purgative Quality. Some of the Salt of this Water, being put into a Solution of Silver, quickly made a Precipitation of the Silver. Mr. *Dundas* says, that some alkaline Liquors, as *Oil of Tartar*, Spirit of *Sal Ammoniac*, &c. being dropt into some of the Water, immediately produced a violent Effervescence; which plainly shews a great Acidity; which he ascribes to the *Alum* in this Water. M. *Senckenberg* found no such Effervescence on mixing these two alkaline Liquors with the Water; but only says it grew milky, and a little white Precipitate subsided. I can account for this material Difference no otherwise, than by supposing, that the Acid, which caused the Effervescence in Mr. *Dundas's* Experiment, was a volatile Gas, which was not quite spent in being carried no farther than *Gloucester*, but which was quite evaporated and flown away before the Water came into M. *Senckenberg's* Hands in *London*: And as to the *Alum*, M. *Senckenberg* did not attend to it.

“ Mr. *Dundas* thinks these Waters may be of Use in a lax Constitution; when the Humours are of an *alcalescent* Nature; but, when *acescent*, must do Hurt.”

XXII. *An Account of a new Purging Spring discovered at Dulwich in Surrey, by Mr. John Martyn, F. R. S. Prof. Botan. Cantab.*

Dulwich is a Village lying about Six Miles South of *London*, at the Foot of that Ridge of Hills which divides the Counties of *Kent* and *Surrey*. The Purging Springs, which have been esteemed for about a hundred Years, and are commonly known by the Name of *Dulwich Waters*, have been improperly so called; those Springs arising in a Valley on the South Side of those Hills, in the Middle of a large Common belonging to the Parish of *Lewsham* in *Kent*; whereas *Dulwich* is on the North Side of the Hills, in the Parish of *Camberwell* in *Surrey*.

There has not been any medicinal Spring observed in *Dulwich*, before that which is the Occasion of this Discourse.

In the Autumn of 1739, Mr. *Cox*, the Master of a well-known House of good Entertainment, called the *Green Man* at *Dulwich*, lying about a Mile beyond the Village, was desirous to dig a Well for the Service of his House, there being no Spring of good Water near it. And as it was probable, that he would be obliged to dig pretty deep, I was willing to observe what *Strata* of Earth he dug through. The first 20 Feet in Depth seemed to be only the Clay, which, in a long Tract of Time, had been washed off from the steep Hill, at the Foot of which his House is situated. It was intermixed with Pieces of Roots and Leaves, and with other Fragments of vegetable Sub-

stances. In digging 40 Feet deeper, the Clay was found of various Colours, brown, blucish, and black; intermixed with a considerable Number of *Pyritæ* or Copperas Stones, and some pretty large Masses of the Waxed-vein or *Lodus Helmontii*, which is also found in great Plenty on the Sea-shore near the *Spaw* at *Scarborough*.

The Well being digged to the Depth of 60 Feet, and no Water appearing, Mr. *Cox* caused it to be covered up, and gave himself no farther Trouble about it that Winter. The following Spring, on my coming down, it was opened. I found 25 Feet of Water, of a sulphureous Smell and Taste, which went off, after the Well had been opened some Days.

As I had a strong Suspicion, that this Water was impregnated with some Mineral, I made an Inquiry into the Nature of it by the following Experiments:

1. It curdled Milk.
2. It became green, when mixed with Syrup of Violets, which Colour disappeared in a few Days.
3. Being poured on Green Tea, it did not acquire any Colour.
4. Being mixed with powdered Galls, it acquired a deeper brown Colour than Rain-water did, and continued turbid; whereas the Rain-water continued clear, after the Galls were subsided.
5. Being shaken in a close-stopped Phial, it dis- ploded a Vapour on opening the Phial before the Commotion ceased, with a more audible Noise than common Water did.
6. Being mixed with Oil of Vitriol, and Oil of Tartar, a much more considerable Ebullition was raised,

raised, than by the Mixture of those Liquors with Rain-water.

7. Six Quarts of this Water, being boiled to a Pint, let fall a large Quantity of a fine, whitish, insipid Powder; and the Water so boiled had a very strong saline Taste, with a Mixture of Bitterness, not unlike the *Sal catharticum amarum*,

8. It let fall a copious white Sediment, on the Addition of the Oil of Tartar, which has the same Effect on a Solution of Alum, or of *Sal catharticum amarum*.

9. The boiled Water, after it had deposited its Earth, precipitated large white Flakes, on the Addition of Oil of Tartar.

10. It differs from a Solution of common Salt. For the Oil of Tartar, being dropped into that Solution, caused only a slight Precipitation, which was soon afterwards absorbed again by the Water.

11. It does not lather with Soap.

Having made these Experiments, I was satisfied, that this new Spring was really a Purging Water, as it has since been found by Experience. Some of Mr. Cox's Family drank of it with Success, which encouraged several other Persons to try it, to their great Advantage.

Being drank fresh, in the Quantity of Five-half pint Glasses, it purges quickly, not sinking, but raising the Spirits.

It is found to be very diuretic.

These Properties of the *Dulwich Water* do not seem to be owing to any of the Materials found in digging the Well. The *Pyritæ* are known to be a Mixture of Iron and Sulphur; but this Water seems

to have hardly any Parts of Iron in it [Exp. 3. and 4.]. The Spirit, with which it abounds, [Exp. 5. and 6.] may, perhaps, be owing to a Fermentation of the Sulphur, which is continually flying off, as appears by the strong Smell of it, after it has been for some time covered up. And Mr. Cox has lately informed me, that a silver Cup, which has been often used in drinking this Water, has acquired a yellowish Colour.

The *Ludus Helmontii* affords nothing but Iron. Nor does the Clay, through which they dug, discover any Salt in its Composition. We may therefore conclude, that the Hill, which lies between the old Wells and this new one, contains the Purgine Salt, with which these Waters are impregnated.

I do not find any material Difference between the old and new Waters, except in the Convenience of drinking them. The old Wells are at a Distance from any House, except some few Huts, and exposed to the Rain and Land-floods, by which they are often injured: The new Well is a Mile or two nearer to London, well secured from any Injuries of the Weather,

December 11. 1740.

John Martyn.

XXIII. *An Observation of the Lights seen in the Air, an Aurora Australis, on March 18. 1738-9. at London, by Cromwell Mortimer, M. D. Secr. to the ROYAL SOCIETY.*

ON Sunday Evening, *March 18. 1738-9.* about half an Hour past Seven, the Sky to the North was very clear, and the Stars shone bright; to the South and South-east, as I was in the Skirt of the Town on the North-west Side, the Sky looked obscured, partly from a Mist, partly from the Smoak of the City. At the same time there appeared a bright Column arising somewhat North of the East, or about the East North-east, which reached up with its Point near to the *Zenith*, but going a little South of it. This Column seemed to be the Boundary of the clear and obscure Regions of the Sky above-mentioned: It had an uniform steady Light, without any Dartings or Shiverings; but it sometimes vanished for a few Minutes, and then returned again all at once, not proceeding from the Bottom, but from the Side next the misty Part of the Sky, as if it were only the Border of the Mist illuminated. About Eight this Column was grown much wider, and all of a Breadth, extending in the same Direction beyond the *Zenith* to the West South-west, as far as I could see for the Houses; the Addition to its Breadth seemed to be all on the Southern Edge of it; this whole Band was of a most beautiful Pink colour. A quarter after Eight, the *Phænomena* remained the same; but to the North North-west there appeared some whitish Clouds about

200 from the *Zenith*: Out of these arose three beautiful Pyramids of Light, which extended very near the *Zenith*; the middle of these Pyramids were of a beautiful Sea-green, which went off gradually in lighter Shades towards the Edges, which were of a bright White; the Colour of these very much resembled the Light of *Phosphorus*. I observed these Columns for some Minutes, and then, going in a-doors, saw no more of the Phænomenon; and was told, half an Hour after, that it was all over; but have been informed since, that it returned again about Ten; when the Redness spread, almost universally, over the Southern Parts of the Heavens.

XXIV. *A Letter from Mr. John Martyn, F.R.S. Prof. Botan. Cantab. to John Machin, Esq; Secr. R. S. and Prof. Astron. Gresham. concerning an Aurora Australis, seen March 18. 1738-9. at Chelsea, near London.*

S I R,

I Now trouble you with a rude Account of the *Aurora Australis*, or what other Name you chuse to call it by, which was mentioned at the Society last *Thursday*.

Sunday, March 18. 1738-9. at half an Hour past Eight, being informed, That there was a great Fire towards *London*, I made haste towards an upper Window that looked to the North North-east; I found an extraordinary Redness in the Air, but of too determined

terminated a Figure to arise from the burning of a House : A broad red Band extended itself to the Northward of the East ; in the Middle of which I very plainly saw *Arcturus*, then about 25° high ; and its Northern Edge touched *Cor Caroli*. It seemed to be fixed and permanent ; not radiating, or fading, as in a common *Aurora Borealis*. This red Band, or Arch, was bounded on the North by Streams of a greenish Blue, in the same Direction ; the most Northern Edge of which touched the Star marked *n* in the Tip of the Tail of *Ursa Major*. After I had considered this Phænomenon for some little time, I retired into my Garden, where I saw a great Brightness almost in the Zenith, but declining to the South-west ; which I found to be a Centre, from which many luminous *Radii*, of which the red Band was much the most considerable, proceeded. This Crown, or Centre, seemed, at that time, as near as I could judge, about the Place of *Cancer* ; for it effaced all the neighbouring Stars, and I could but just see two Stars, which I take to be those in the Heads of the *Twins* ; when the Brightness was most faded : It would sometimes almost disappear for near a Minute, and then kindle again, and dart Rays on all Sides ; but those to the West and North were short, pale, and soon disappeared. Those which shot Southward, were of a fiery Red ; and the whole Southern Part of the Atmosphere was tinged with a red Brightness, which did not however reach quite down to the Horizon ; for, to the South-west, where my Prospect was least confined, I could see *Sirius*, then about 15° high beyond the red Light. The Houses opposite to mine hindered me from seeing, how far to the East and North-east
the

the red and blue Rays extended. All this while, the North and North-west Parts of the Heavens seemed dark, by reason of the great Brightness in the East and South: It was very clear however, and the Stars visible. About Nine, the red Band had covered the Tail of *Ursa major*, having moved considerably towards the North, the Centre continuing in the same Place; and by degrees it faded so as not to be distinguishable from the common Redness which was spread over so considerable a Part of the Heavens. About Ten I went to the River-side, where I had a large Prospect to the South-east; and found all that Part covered with a dusky Red, ~~quite down to the Horizon.~~ There were afterwards some faint Rays darted, sometimes from the Centre of this Phenomenon, which has the Appearance of a common *Aurora Borealis*. If you can gather any thing material from this Description, it will be a Pleasure to,

S I R,

Your most obedient

humble Servant,

John Martyn.

XXV. *Part of a Letter from the Reverend Mr. Timothy Neve, Secretary of the Gentlemen's Society at Peterborough, to Dr. Mortimer, Member of the same Society, and Sec. R. S. concerning the same Aurora Australis.*

* * * * *

WE had, on *Sunday* Night last, *March* 18. from about half an Hour after Seven, till almost Nine o'Clock, an *Aurora Australis*, which spread with Variety of Colours all over the Horizon, meeting in a Centre almost vertical, but somewhat inclining to the South. The original Colours were so mixed and blended in the common Centre, as, by the vast Variety easily distinguished, made a beautiful Appearance. The fainter Colours came from the two opposite Points of the North-west and South-east: The Blood-red Crimson, &c. were seen chiefly in the North east and South-west. The Wind, I think, full North; but very still. The three preceding Days, *Thursday*, *Friday*, and *Saturday*, were excessive cold; the Barometer fell Eight or Nine Degrees, and we had very great Quantities of Snow, Hail, and Rain, most of that Time; and, if I remember right, the Lights in the Air, of late Years, appear after such Storms, especially for Ten Years past, when our Winters have been unseasonably mild, and our Summers cold and rainy. I am, Sir,

*Your most obedient
humble Servant,*

Tim. Neve.

XXVI. *A Description of a Catheter, made to remedy the Inconveniencies which occasioned the leaving off the High Operation for the Stone; by Archibald Cleland, Surgeon to General Wade's Regiment of Horse.*

AS this Operation was left off very precipitately, in order to introduce that Method now called the *Lateral Operation*, which has been practised for some time with good Success; notwithstanding, had the Operators at that time had the Advantage of this Instrument I here offer to this Honourable Society, I am persuaded the Advantage would have been more than equal in favour of this *High Operation*, and preferable to any other Method yet practised: And I humbly hope, that the Description, and the Method of using this *Catheter*, will be a means of reviving an Operation so happily begun, and calculated for the Good of those that are afflicted with the Stone in the Bladder.

This *Catheter* is made either of Silver or Steel, of different Sizes, to suit different Ages; and has the outward Appearance of a common *Catheter* [TAB. VII. Fig. 1.], and will answer the same Uses: But, in respect to this Operation, it differs from the common in this, that it is composed of Two Legs [Fig. 2.], with blunt Points, a long Tube, a Sliding bolt; and a Handle, which serves to open and shut the Legs: The Bolt, which is fixed to the Extremity of the Tube, goes into Two Holes, fixed in the Plate of the Handle: The
 one

one serves to keep the Legs close during the time it is to be introduced into the Bladder, the other to extend the Points at the Distance of an Inch or more, during the time the Operation is performing.

The Method of using this *Catheter* is, first, (after having taken the necessary Precautions, and filled the Bladder) to introduce the *Catheter* into the Bladder, then unbolt it at the Handle, and by holding the Tube in one Hand, and the Handle that moves the Legs in the other, then turn or open the Legs, till the Bolt becomes opposite to the Second Hole upon the Plate into which the Bolt must be thrust; then by pressing gently the Handle downwards betwixt the Patient's Legs, the Two blunt Points will be easily felt above the *Os Pubis*, in the Protuberance made by the Injection into the Bladder.

The Advantages I propose by using this Instrument, are these: First, To be a Director for the Operator, in determining the Place where the Puncture is to be made in the Bladder; it also serves as a Support to the Bladder, when the Water flows out; and keeps it from subsiding during the Time of the Operation, and till the Stone is extracted: It serves likewise to resist the Pressure of the abdominal Muscles and *Peritoneum*, and also hinders the *Intestines* from being forced down upon the Knife; and keeps the Orifice open, till the Stone or Stones are brought away. And, lastly, by the Help of this Instrument it may be discovered, whether the Bladder is indurated or scirrhus.

The Method of performing this Operation, with Safety, is, after having introduced and fixed the *Catheter* with its Legs open, to feel for the Two Points

above the *Os Pubis*, and place the Finger and Thumb gently upon them; then give the Handle to an Assistant, to keep it firm in that Position; then, with the Knife in the Right Hand, make a Puncture at once into the Bladder, exactly in the Middle betwixt the Points; but, for the more Security, somewhat lower nearer the *Os Pubis*; and, without drawing out the Knife, make a large Incision downwards, inclining under the Arch of the *Pubis*, in proportion to the Bigness of the Stone, taking care not to wound the Catilage that joins the Bones together, when the Knife is withdrawn: The Bladder being thus supported, the Stone may be extracted with the Fingers, or with a small Pair of Tenets, there being little Danger of breaking it in this Method. When the Operation is finished, raise the Handle of the *Catheter*, and unbolt it; shut it close and fix it so; then withdraw the *Catheter*, and dress the Patient. ..

April 5, 1739.

See TAB. VII.

Fig. 1. *The Catheter, as it is to be introduced into the Bladder, the Two Legs A and B being closed together.*

Fig. 2. *The Catheter, its Two Legs A, B, being open.*
C, D, *The Tube.*

E, *The Sliding bolt.*

F, *The Two Holes into which the Bolt is to be slid.*

G, *The Ears fixt to the Tube C, D, which is all of one Piece with the Leg A.*

H, *The Handle, which opens the Legs; this Handle is all of one Piece with the*
the

the Leg B, which Leg B is a Continuation of a Wire, that runs through the Tube C D, and is fastened to the Handle H, and turns with it.

XXVII. *A Description of Needles made for Operations on the Eyes, and of some Instruments for the Ears, by the Same.*

THE first differs from a common Couching-needle, [TAB. VII. Fig. 3.] in this, that it is made of Two Pieces of Steel soldered together, and fixed in a Handle [Fig. 4.]: At a little Distance from the Handle they separate, and have; in each *Lamina*, a Button fixed, which passes through a Hole in the other; from this Part to the Points, they are so nicely applied, and polished together, that they cut, and have the Shape of a common Needle: Upon pressing the Buttons, the Points are separated, and in the Inside of the broad Part of the Points are several small Indents, to prevent any thing from slipping, after it has once got hold.

The Use of this Needle is, either to depress a Cataract; or, if it should be found of such a Nature as to bear to be taken hold of, then, by opening the Points, to engage it, and carefully bring it out of the Eye.

If it should happen, that in depressing the Cataract, or in bringing it out of the Eye, some of the small Vessels are wounded, and some Drops of Blood diffuse themselves in the aqueous Humour; this second Needle [Fig. 5.] is made with Design to remedy this Inconveniency. It

It is a long, small, round Stilet [*Fig. 6.*], gradually decreasing from the Handle to the Point; and is fitted to a long Silver Tube of the same Shape [*Fig. 7.*], into which the Needle is put, and the Point comes out at the End one Quarter of an Inch. This is to be introduced into the Eye at the Orifice the other Needle had made: When it is so far introduced, as the End of the Tube is within the posterior Chamber of the aqueous Humour, the Needle is to be withdrawn, leaving the Tube in the Eye; and then, with the Mouth, may be sucked into the Tube, all the Blood, and watery Humour, that is contained there, or any other floating Particles: Then the Tube is to be withdrawn, and the Eye left to replenish itself with the aqueous Humour again; which will take Twelve or Eighteen Hours at most.

The following Instruments are proposed to remedy some kinds of Deafness proceeding from Obstructions in the external and internal auditory Passages.

IN order to discover, with more Exactness, whether the Disorder lies in the outward Ear, I make use of a convex Glass, Three Inches in Diameter, fixed in a Handle, [*TAB. VII. Fig. 8.*] into which is lodged some Wax Candle, which comes out at a Hole near the Glass, and reaches to the Centre; which, when lighted, will dart the collected Rays of Light into the Bottom of the Ear, or to the Bottom of any Cavity that can be brought into a strait Line, Therefore, when it is discovered by the Help of this Glass, and lighted Candle, that the Ear is full of hard Wax, which will
not

not bear to be taken out with the *Forceps*, the Method is to have a small Boiler, wherein are put some proper Herbs; and, by different Tubes of various Sizes, the Steam is conveyed to the Bottom of the Ear. In a short time, the Wax will dissolve, and the Person find great Ease. In one of these Tubes, are placed Two Valves, to regulate the Heat to the Person's Inclination. If this has not the desired Effect, and the Person still remains deaf, the following Instruments are made to open the *Eustachian* Tube: If, upon Trial, it should be found to be obstructed, the Passage is to be lubricated by throwing a little warm Water into it by a Syringe joined to a flexible silver Tube, which is introduced through the Nose into the oval Opening of the Duct at the posterior Opening of the *Nares*, towards the Arch of the Palate. The Pipes of the Syringe are made small, of Silver, to admit of bending them, as Occasion offers; and, for the most part, resemble small Catheters: They are mounted with a Sheep's Ureter [*Fig. 9.*]; the other End of which is fixed to an Ivory Pipe; which is fitted to a Syringe, whereby warm Water may be injected: or they will admit to blow into the *Eustachian* Tube, and so force the Air into the Barrel of the Ear, and dilate the Tube sufficiently for the Discharge of the excrementitious Matter that may be lodged there. The Probes, [*Fig. 10.*] which are of the same Shape with the Pipes, have small Notches near the Points, which take in some of the hardened and glutinous Matter, that is contained in those Tubes, which is distinguished by the fetid Smell, when the Probes are withdrawn.

There

There is another Kind of Deafness, which proceeds from a violent Clap of Thunder, Noise of a Cannon, or the like. In this Case, it is probable, that the Position of the *Membrana Tympani* is altered, being forced inwards upon the small Bones, and so becomes concave outwardly. In this Case no Vibration of Sounds will be communicated to the Drum, until the Membrane has recovered its natural Position. The Means, proposed to remedy this Disorder, are, first, (if the Person heard very well before; and it be not too long after the Accident has happened) to oblige the Patient to stop his Mouth and Nose, and force the Air through the *Eustachian* Tube into the Barrel of the Ear, by several strong Impulses; which will, probably, push the Membrane back to its natural State.

But if, by any Accident, the Excrement is harden'd in the Tube, or the Orifice of it, which opens into the Barrel of the Ear, should be stopped up, so as that no Air can be forced that Way, the second Method proposed, is to introduce into the *Meatus auditorius externus*, an Ivory Tube [*Fig. 11.*], as near to the Drum as can be done, and so exactly fitted, that no Air can go in or out, betwixt the Skin of the external *Meatus* and the Tube. When it is thus fixed, I take the further small End in my Mouth, and, by degrees, draw out what Air is there contained; and, I believe, it will act like a Sucker upon the Membrane, and draw it back to its natural State; and then the Person will hear as before. If this should fail, I should be apt to believe the violent Shock this Membrane has suffered, may have dislocated some of the small Bones; in which Case there is scarcely any Remedy. And
for

for the Diseases that are called *Nervous*, I must leave them to the learned Gentlemen of the Faculty,

In this Ivory Tube may be fixed a Bra's Cock [Fig. 12.], which, being turned, will hinder the rushing in of the Air, while the Person who sucks, takes Breath, and can renew his Snæion.

The flexible silver Tube, for injecting the *Eustachian* Tube, may be used without the Sheep's Ureter, by being screwed on to a small silver Syringe, as at Fig. 13.

XXVIII. *Part of a Letter from Mr. Stephen Fuller, Fellow of Trinity College, Cambridge, to his Father John Fuller, Esq; senior, F. R. S. concerning a violent Hurricane in Huntingdonshire, Sept. 8. 1741.*
Communicated by Sir Hans Sloane, Bart. late Pr. R. S.

Cambridge, Sept. 9. 1741.

Yesterday was the most violent Hurricane of Wind in these Parts, that ever was known since the Memory of Man. *Cambridge* was not in the midst of the Hurricane, so that it has escaped very well. I happened to be paying a Visit to Dr. *Knight*, a Cotemporary of yours, of our College, who lives at *Blunfham* in *Huntingdonshire*, about 10 Miles North west of *Cambridge*. We were in the midst of the Hurricane; but, by getting into the strongest Part of the House, we escaped without any great Danger. The Morning, till half an Hour after Eleven, was still, with very hard Showers of Rain: At half an Hour

after Eleven it began to clear up in the South, with a brisk Air, so that we expected a fine Afternoon : The South-west cleared up too, and the Sun shining warm drew us out into the Garden. We had not been out above 10 Minutes, before we saw the Storm coming from the South-west : It seemed not to be 30 Yards high from the Ground, bringing along with it a Mist, which rolled along with such incredible Swiftnefs, that as near as we could guess, it ran a Mile and an half in half a Minute : It began exactly at 12 o'Clock, and lasted about 13 Minutes, Eight Minutes in full Violence : It presently unhealed the House we were in, and some of the Tiles, falling down to Windward, were blown in at the Sashes, and against the Wainscot on the other Side of the Room ; the broken Glas was blown all the Room over, the Chimneys all escaped ; but the Statues, which where on the Top of the House, and the Balustrades from one End to the other, were all blown down. The Stabling was all blown down, except Two little Stalls, where, by the greatest Fortune in the World, stood my Horse and the Doctor's. All the Barns in the Parish, except those that were full of Corn quite up to the Top, were blown flat upon the Ground, to the Number of about 60. The Dwelling-houses escaped to a Miracle ; there were not above a Dozen blown down out of near 100. The Alehouse was levelled with the Ground, but by good Luck not a Soul in it. If the Storm had lasted Five Minutes longer, almost every House in the Town must have been down ; for they were all, in a manner, rocked quite off from their Underpinnings. The People all left their Houses, and carried their Children out to the
Wind -

Windward Side, and laid them down upon the Ground, and laid themselves down by them; and by that means all escaped, but one poor Miller, who went into his Mill to secure it against the Storm, and was blown over, and crushed to Death betwixt the Stones and one of the large Beams: I saw him taken out. All the Mills in the Country are blown down: I do not hear of any more bodily Mischief; only one Miller at *Willingham*, so much bruised, that they hardly expect his Life. Hay-slacks and Corn-slacks are some quite blown away, some into the next Corner of the Field. The poor Pigeons, that were caught in it, were blown down upon the Ground, and dashed to Pieces; one of which I found, myself, above half a Mile from either House or Hedge. Where-ever it met with any boarded Houses, it seemed to exert more than ordinary Violence upon them, and scattered the Wrecks of them for above a quarter of a Mile to the North east, in a Line: I followed one of these Wrecks myself; and, about 150 Yards from the Building, I found a Piece of a Rafter, about Feet long, and about Six Inches by Four, stuck upright Two Feet deep in the Ground; and at the Distance of 400 Paces of my Horse, from the same Building, was an Inch Board, Nine Inches broad, 14 Feet long: I am convinced, that these Boards were carried up into the Air; for I saw some, that were carried over a Pond above 30 Yards; and I saw a Row of Pales, as much as Two Men could lift, carried Two Rods from their Places, and set upright against an Apple-tree. Pales, in general, were all blown down, some Posts broke off short by the Ground, others torn up by the Stumps. The whole Air was full of Straw:

Gravel-stones, as big as the Top of my little Finger, were blown off the Ground in at the Windows; and the very Grass was blown quite flat upon the Ground. After the Storm was over, we went out into the Town, and such a miserable Sight I never saw: The Havock I have described; the Women and Children crying, the Farmers all dejected; some blessing God for the Narrowness of their Escape, others wondering how so much Mischief could be done with one Blast of Wind, which hardly lasted long enough for People to get out of their Houses. I talked to Two People, that were out in it all the Time, who said, that they heard it coming about half a Minute before they saw it; and that it made a Noise something resembling Thunder, more continued, and continually increasing. I saw a Man in the Afternoon, who came from *St. Ives*, who says, the Spire of the Steple, which is one of the finest in *England*, is blown down, as is the Spire of *Hemmingford*, the Towns having received as much Damage as *Bluntsham*. There was neither Thunder nor Lightning with it, as there was at *Cambridge*, where it lasted above half an Hour, and consequently was not so violent. Some few Booths in *Starbridge-fair* were blown down. The Course of the Storm was from *Huntington* to *St. Ives*, *Erith*, between *Wisbich* and *Downham* to *Lynn*, and so on to *Snettisham*: We have heard nothing of it farther to the South-west than *Huntington*, nor farther North-east than *Downham*. Very few Trees escaped: The Barns that stood the Storm, had all their Roofs more damaged to the Leeward Side than to the Windward. We are in great Hopes the Storm was not general; I am apt to think it was much such a Storm as ran through

through *Sussex* about 10 Years ago. The Storm was succeeded by a profound Calm, which lasted about an Hour; after which the Wind continued pretty high, till 10 o'Clock at Night.

To Sir HANS SLOANE, *Bart. &c.*

Honoured S I R, *Roselill, Sept. 13. 1741.*

THE above-written is Part of a Letter from my Son *Stephen Fuller*, Fellow of *Trinity College* in *Cambridge*; which is so particular an Account of a terrible Storm on *Tuesday* last, in *Huntingtonshire*, in which he was present, as may deserve to be communicated to the ROYAL SOCIETY, if you think fit. I am

Your most dutiful Son,
and humble Servant,

J. Fuller.

XXIX. *Extract of Letters from Mr. T. Sympson, to Brown Willis, Esq; Member of the Society of Antiquaries, and to James West, Esq; Member of the Same, and Treas. R. S. by the Publisher, concerning the Remains of a ROMAN Hypocaustum or Sweating-Room, discovered under-ground at Lincoln, Anno 1739.*

MR. CHANTER having set some Labourers to dig a Cellar in an Outhouse (belonging to his Manſion) fronting the West End of the *Minster*, and

adjoining to the Chequer-gate ; they found Two or Three Stone Coffins, which had probably lain there ever since the Demolition of the ancient Parish church of *St. Mary Magdalen*, to make way for the Foundation of the Cathedral, and its Appendages : But going lower, about 10 or 11 Feet deep, they found some Building ; and at 13 Feet, to their no little Surprize, they struck into the Corner of a Vault. Mr. *Sympton* took it to be a ROMAN *Hypocaustum* : He had the Dimensions of it taken, as in the Plan ; see TAB. VIII. *Fig. 1.* and the Profile, *Fig. 2.*

A. The *Præfurnium*, [Stoking-place] Entrance or Place, where the *Fornacator* [the Stoker] stood to manage the Fire. It is 3 Feet 6 Inches square, its Height not certainly known, because of the Rubbish which lay at the Bottom.

B. The *Fornax*, Furnace, or Fire-place, built of Brick, and arched over with the same. Its Length from *E* to *G*, 5 Feet 6 Inches ; its Height 3 Feet at *E*, but 4 Feet at *F*, rising gradually ; 3 Feet 6 Inches long from *E* to *F*, and 2 Feet wide between *E* and *F* ; 2 Feet long from *F* to *G*, and but 19 Inches wide between *F* and *G*.

C. The *Alveus* [or Body of the Kiln], 21 Feet 4 Inches long ; 8 Feet 4 Inches broad ; and 2 Feet 4 Inches high. The Floor is made of a strong Cement composed of Lime, Sand, Brick-duft, &c. which the Masons of that Country call *Terrace-mortar*. Upon this Floor stand Four Rows of low Pillars, made of Brick, 11 in a Row ; the outside Rows round, the Two inner Rows square : The round ones are about 11 Inches Diameter, the others 8 Inches square : Each standing on a Brick 11 Inches square, as at *Fig. 4.* and

2 Inches thick ; the Shaft 2 Feet high, upon which lies another Brick likewise 2 Inches thick, some 17, 18, and others 19 Inches square, as at *Fig. 3.* which represents the Profile of Two square Pillars with the square Bricks at Top and Bottom, which make the whole Height of the *Alveus* 2 Feet 4 Inches. The Pillars, both round and square, are jointed with Mortar, and that very clumsily : The round Pillars being composed of 10 Courses of semicircular Bricks, as at *Fig. 4. A*, laid by Pairs; the Joint of every Course crossing that of the former at right Angles, as at *Fig. 4. C*; with so much Mortar betwixt, that the Two Semicircles rather form an Oval, and so the Pillars look at first Sight as if they were wreathed : The square Pillars are composed of 13 Courses of Bricks, as at *Fig. 4. B*; 8 Inches square, as at *Fig. 4. D*; these Bricks being thinner than those which compose the round Pillars.

On the Top of these Pillars rests the *Testudo* or Floor of the *Sudatorium* or Sweating-Room, *Fig. 2. HI*, which is composed thus: First, there is a Floor of large Bricks, 23 Inches long, and 21 broad, which lie over the square Bricks on the Tops of the Pillars, as at *Fig. 3.* the Four Corners of each Brick reaching to the Centres of Four adjoining Pillars, as at *Fig. 5.* where only one of these larger Bricks is represented, as it bears upon Four of the smaller Bricks with their Pillars under them. On this Course of Bricks is a Covering of Cement 6 Inches thick, and upon that is set a tessellated Pavement: The *Tessellæ* of the Corner uncovered, *K*, in *Fig. 1* and 2. are of a whitish Colour.

L and *M*, in *Fig. 1* and *2*. are Two *Tubuli* or Flues, 12 Inches wide and 14 deep, for carrying off the Smoke: The Bottoms of them are even with the Bottom of the *Alveus*, and they are carried upon the Level about 15 Feet, under another Room by the Side of the *Hypocaustum*, and then it is presumed they turn upwards. The Walls of this Room were plaistered, and the Plaister painted red, blue, and other Colours, and its Floor tessellated white; no Figures discernible in either Painting or Pavement. This Pavement, which is on a Level with the *Testudo* of the *Hypocaustum*, is about 13 Feet below the present Surface of the Ground: So deep is old *Lindum* buried in its Ruins! The Workmen, in digging up this Pavement, struck into the Flue *M*, 3 Feet from the North-east Corner of the *Hypocaustum*; and opened it to the very Corner *K*, which shewed one of the round Pillars, and so the Whole was discovered. In sinking the Hole *NK*, at 5 or 6 Feet Depth, they came to the Wall, which was dug up by Pieces with the Rubbish, before they came to the Pavement. This had been the Wall of a Room under which the *Tubuli* ran, by the Side of, and not over the *Alveus*, but on the East Side of it.

Mr. *Sympton* got a Youth to creep in at the Opening made at *K*, and take the Dimensions of the several Parts, who, the *Alveus* being quite black with Smoke, returned like a Chimney-sweeper; but could not take the exact Measures of the *Fornax* and *Præfurnium*, on account of Rubbish he found in them: Wherefore, Mr. *Sympton*, being desirous to inform himself thoroughly of all the Parts of this curious Piece of Antiquity, with the Leave, and at the Expence, of the Pro-

Proprietor, caused another Hole to be sunk 16 Feet deep, and by driving a Level *OP*, see *Fig. 1* and 2. he broke into the Middle of the *Fornax*; and, having cleared it of Rubbish, found its Dimensions as above, and that the Bottom of the narrowest Part between *F* and *G*, was raised 18 Inches higher than the Bottom of the Part between *E* and *F*.

The *Præfurnium* was covered over at Top with a large flat Stone.

The *Fornax*, and the Two square Pillars in the *Alveus* fronting the Opening of the *Fornax*, were greatly impaired by the Fire, which must have been very violent: Some small Fragments of Wood-coal were thrown out among the Rubbish in the Bottom of the *Fornax*; whence probably it was heated with Wood.

At the Conclusion of the Account Mr. *Sympton* sent to Mr. *Willis*, he gives us the following Remark upon a Passage in the second Letter from Mr. *Baxter* to Dr. *Harwood*, concerning the *Hypocausta* of the *Antients*, printed in their *Transactions*, N^o 306.

“ Mr. *Baxter* says, the *Hypocaustis* was called *Alveus* and *Fornax*: But, with due Deference to that
 “ learned Gentleman, (says Mr. *Sympton*) I humbly
 “ apprehend them to have been distinct Parts of the
 “ Whole, which was called *Hypocaustis*: The Ground
 “ of my Conjecture is this: In the first Place, it
 “ would hardly be possible to make a Fire in that
 “ Part of this *Hypocaust*, which I call the *Alveus*;
 “ much less to come at it, to manage it, being so
 “ low, and so crowded with Pillars, as to admit only
 “ a slender Person to crawl amongst them, and that
 “ not

“ not without Difficulty. In the next Place, the
 “ Floor does not seem designed for it, nor are
 “ there any Appearances of Ashes on it: And,
 “ further, that the *Fornax* was, where I have
 “ placed it in this, appears not only from the Stru-
 “ cture of that Part, but from the Bricks being much
 “ burnt [and Pieces of Wood coal being found in
 “ it]; whereas in the *Alveus*, the Bricks are only
 “ black with the Steam and Smoak being drawn
 “ through it by the *Tubuli*. But I submit my Opi-
 “ nion to your better Judgment.” He might have
 added, that only those Pillars in the *Alveus*, which
 faced the Mouth of the *Fornax*, had suffered much by
 the Fire, the others not:

That *Hypocaust*, described in N^o. 306. above-men-
 tioned, must have been a much hotter Room than
 this; for, instead of the Flues being carried under
 another Room, the Walls of the Sweating-room itself
 were hollow or double, and a great Number of Flues
 carried up between them all round the Room. A
 curious Model of this is still to be seen in the *Mu-
 seum* of the ROYAL SOCIETY.

XXX. *Accounts of a Capricorn Beetle, found alive in a Cavity within a sound Piece of Wood, and of the Horn of a Fish struck several Inches into the Side of a Ship; by C. Mortimer, M. D. Secr. R. S.*

ABOUT Michaelmas 1728. I went to *Portsmouth* with some Friends, where having taken a View of his MAJESTY's Yard and Docks for building Ships of War; and satisfied my Curiosity in examining several curious Contrivances used in Naval Architecture; Mr. *Bankley*, the Clerk of the Survey, invited me to his House, where he shewed me the Insect as represented in TAB. VIII. *Fig.* 6. and 7. The People of the Yard were much alarmed at it, none knowing what to make of it; and all imagining it was venomous. On opening the Piece of Wood, (which was tied together with a Packthread) I found this Animal yet alive, and moving in a large Cavity in the Middle of the Wood, which appeared otherwise sound, having no visible Entrance into it. This Beetle, being turned out upon a Sheet of Paper, crawled about upon it. Mr. *Bankley* gave me the following Account of it: " This Insect was found *August* 26. 1728. " in splitting a Piece of Exotic Wood into Two " Pieces, cut across the Grain $4\frac{1}{2}$ Inches thick, taken " up in the Hold of his MAJESTY's Ship *Bredah*, " when in the Dock at *Portsmouth*, after her Return " from the *West-Indies*: It lived upwards of a Month " afterwards. The Hole in which it was nourished,

• § T 2

" was

“ was 5 Inches deep, and $2 \frac{1}{4}$ Inches by $1 \frac{1}{4}$ Inch
 “ broad, in the great Piece ; 2 Inches deep, and $2 \frac{1}{4}$
 “ Inches by $1 \frac{1}{4}$ Inch broad, in the smaller Piece.
 “ There was not the least Sign of any Defect on the
 “ Outside of the Wood, but it appeared very fair and
 “ sound; the Inside was porous, having a Grain like
 “ Cedar, but in Colour not unlike yellow *Sanders*.”

On Examination, I found this Insect to be a sort of *Scarabæus* called *Capricornus* from its long Horns; which in this were very much crumpled, and partly broken off against the Wood, in its Confinement: Its Wings were likewise crumpled on the same Account. The Females of these Insects usually lay their Eggs in the Crevices of the Bark of Trees: So it is probable, that as soon as this Insect was hatched in Form of a Worm, it gnawed its Way through the Bark into the Wood; and that afterwards the Hole it had made in the Wood, closed towards the Outside; and the Worm, still continuing to gnaw deeper, formed the large Cavity; and then taking its perfect Form of a Beetle, remained in that hollow Place, where the Sap of the Tree arising, might have supplied it with Nourishment, and even Air; since it is known, by various Experiments, that Air will insinuate itself, where-ever such Fluids, as contain Air in them, can penetrate.

I have seen in the magnificent *Museum* of Sir *Hans Sloane*, Bart. a Piece of Wood, sound without, having a Cavity within, wherein was found alive a sort of Beetle, but I think of a different *Species*. It came from *Jamaica*, if I remember right.

At the same time, that curious Gentleman Mr. *Bankley* shewed me the *Horn* of a *Fish* that had penetrated above 8 Inches into the Timber of a Ship [see

TAB.

TAB. VIII. *Fig. 8.*]; and gave me the following Relation of it: "His MAJESTY'S Ship *Leopard*, having
 "been at the *West-Indies*, and on the Coast of
 "Guiney, was ordered by Warrant from the Ho-
 "nourable *Navy-Board*, dated *Aug. 18. 1725.* to be
 "cleaned and refitted at *Portsmouth* for Channel-
 "Service: Pursuant thereto, she was put into the
 "great Stone-dock; and, in stripping off her Sheath-
 "ing, the Shipwrights found something that was
 "uncommon in her Bottom, about 8 Feet from her
 "Kcel, just before the Fore-mast; which they search-
 "ing into, found the Bone or Part of the Horn of
 "a Fish of the Figure here described; the Outside
 "rough, not unlike *Seal-skin*; and the End, where
 "it was broken off, shewed itself like coarse Ivory.
 "The Fish is supposed to have followed the Ship,
 "when under Sail, because the sharp End of the
 "Horn pointed toward the Bow: It penetrated with
 "that Swiftneſs or Strength, that it went through
 "the Sheathing 1 Inch thick, the Plank 3 Inches
 "thick, and into the Timber $4\frac{1}{2}$ Inches."

With what prodigious Force must this Fish have moved? For had it met the Ship, the Motion of the Ship would have assisted the Penetration of the Horn; but the Direction of it pointing from the Stern towards the Head, shews that the Fish struck against the Ship, either while at Anchor; or that it overtook it, while under Sail; in which case the Force of the Fish must have been still greater; and this was probably the Case, because nobody in the Ship remembered the Shock. Several able Workmen on the Spot assured me, that, with a Hammer of a Quarter of an Hundred Weight, they could not drive in a Pin of Iron, of the same Form and Size, into such
 fort

fort of Wood, and to the same Depth, in less than Eight or Nine Strokes.

XXXI. *Abstracts of the original Papers communicated to the ROYAL SOCIETY by Sigismund Augustus Frobenius, M. D. concerning his Spiritus Vini Æthereus: Collected by C. Mortimer, M. D. Secr. R. S.*

DR. *Frobenius* being dead, and some learned Chemists at *Paris*, in *Germany*, and in *Italy*, having endeavoured, in various Manners, and with different Contrivances, to make this *Æthereal Spirit*; I thought it would be acceptable to the Curious in *England*, to give them an Abstract of the Three Papers the Doctor communicated to the ROYAL SOCIETY concerning his *Spiritus Vini Æthereus*. The First he gave in on *Feb. 19. 1729-30.* along with what is printed in N^o 413. p. 283. of these *Transactions*, but was desired by the Author not to be published at that Time. In this Paper he says, you must “ take of
“ Oil of Vitriol, and the highest rectified Spirit of Wine,
“ equal Parts by Weight, not by Measure: That the
“ Oil of Vitriol was to be poured by little and little
“ into the Spirit of Wine, because they will grow hot
“ upon mixing; that they should be shaken often, that
“ they may mix thoroughly; then to be digested gently
“ in a glass Retort, and a large Receiver to be applied
“ and luted on, lest the subtille Spirits should fly away:
“ Then distil them in an *Athanasor*, in gentle Digestion,
“ for Three Days; and pour back the distilled Liquor,
“ till

“ till the Liquor in the Recipient appears double, or of Two Sorts. Thus far he says, Sir *Isaac Newton* was acquainted with the Process*.”

He then proceeds almost in the very Words of the late Mr. *Godfry* [*Hanckewitz*] as printed in the *Transaction*, quoted above, p. 289.

He concludes, by telling us, that the First Part of the Process, till one comes to the Separation of the Two Liquors is mentioned by *Caneparius*, in his Book *de Atramentis*, first printed at *Venice*, and afterwards at *London*; then by the great Mr. *Boyle*; afterwards by Sir *Isaac Newton*: That Dr. *Stahl*, and Professor *Hoffmann*, were the first in *Germany* who knew the first Operation from *Kunckel*; but neither of them brought it to Perfection, or knew the Effects of it †. In *France* M. *Homberg* undertook an Experiment somewhat analogous to this, with Sulphur and Oil.

The Second Paper was communicated on the 12th of *February* 1740-1. in *Latin*, and contains an ample Account of the whole Process, with Improvements and Additions: But as the Author in his Third Paper, given in *Feb.* 19. 1740-1. in *English*, says that that is the truest and most advantageous Process, I shall present it to the Reader as follows, only subjoining the Differences and Additions in the Second Paper, by way of Note or Explication.

* So long ago as the Time of *Raymund Lully* this Process was in Use: See his *Epist. accuratatoria*, p. 327. and *Weidenfeld's* Secrets of the Adepts, p. 251.

† But *Baron* at *Vienna*, knew the whole Process; and it is said *Frobenius* learned it of him.

TAKE Four Pounds in Weight of the best Oil of Vitriol, and as much in Weight (not Measure) of the best *Alcohol*, or the highest rectified Spirit of Wine.

1. First, pour the *Alcohol* into a chosen glass Retort; then pour in, by little and little, One Ounce of Oil of Vitriol; then shake the Retort, till the Two Liquors are thoroughly mixt, when the Retort will begin to grow warm; then pour in more of the Spirit of Vitriol, and shake it again; then the Retort will become very hot. Do not pour in the Spirit of Vitriol too fast, or too much at a time, lest the glass Retort, by being heated too suddenly, should burst. You must allow about an Hour's time for pouring in the Spirit of Vitriol, not pouring in above an Ounce at a time, and always shaking the Retort, till the whole Quantity of the ponderous mineral Spirit is intimately united with the light inflammable vinous Spirit.

2. In the next place, examine with your Hand the Heat of the glass Retort, and have a Furnace ready, with the Sand in the iron Pot, heated exactly to the same Degree as the Retort has acquired by the Mixture of the Two Liquors: Take out some of the Sand, and, having placed your Retort in the Middle of the iron Pot, put in the hot Sand again round the Retort, and apply a capacious Receiver to it; set it into cold Water, and wrap it over with double Flannel dipped in cold Water.

Raise your Fire gradually *, that the Drops may fall so fast, that you may count Five or Six between each,

* Force it from the Beginning with a pretty strong Fire, that not only the Spirit of Wine be carried over, but the Oil of Vitriol along with

each, and that beside this quick Discharge of the Drops, the upper Hemisphere of your Receiver appear always filled with a white Mist or Fumes : Continue this Heat as long as they emit the Scent of true Majoram *.

As soon as the Smell changes to an Acid, suffocating one like that of Brimstone, take out the Fire, and lift the Retort out of the Sand, and change the Receiver ; for all that arises afterwards is only a mere Gas of Brimstone, and of no Use †.

If you do not use the greatest Precaution, the Liquors in the Retort will run over ; the Fire must cease, as soon as the æthereal Spirits are gone over ; for there remains behind an *Oleum Vinæ*, which is extracted by the Force of the Acid out of the Spirits, which will arise, run over, and often cause Explosions ||.

The

with it ; which will most certainly happen, if a middle Degree of Heat be kept up, between a reverberatory Heat and the other Degrees of Fire For the Spirit of Wine being mixt with the vitriolic Acid in equal Weight, but by unequal Measure ; the Spirit taking up double the Room of the Oil, does in a wonderful manner make up the Deficiency of the highest Degree of Heat.

Towards the End, the Scent will more resemble that of *Arrack* ; continue this Heat for about Three Hours, till the Scent becomes offensive, and like that of *Gas Sulphuris*.

† At this time you will see black Fire arising, which will certainly burst your Glass, and destroy your Work, if continued.

|| The Retort with its Receiver being removed, set them by in a cold Place, and when all are thoroughly cold, separate the Receiver from the Retort : There will be Two different Liquors in the Receiver, which pour off through a glass Funnel into a glass Bottle, which stop up very carefully.

The Liquor will be of Two Sorts ; that which swims at Top, inflammable, of the Nature τὸ φλογεόν ; that which sinks to the Bottom, like

The Second Day, when your Glass is cold, infuse the Remainder, with half as much *Alcohol**; and distil again as before, and you will have the same: The Third Day again, with as much, and proceed as at first, it gives it again. Go on as long as you can obtain any (of the æthereal Spirit) till all turns to a *Carbo*. Then separate it, and *alkalize* it with Spirits of *Salt Armoniac* made without Spirits of Wine, till all Effervescence ceases; and distil it once more *è Balneo Mariæ*: So is it ready for Experiments†.

There are more Products to be got from this Process; as, 1st, A balsamic Oil. 2^{dly}, A *Terra foliata Tartari* of a glittering Nature, not fusible, as is the common, prepared with Wine-vinegar, and fixt Salt, which is of great Use in Medicine: And, 3^{dly}, A purple Earth out of the *Caput Mort*.

The

like *Gas Sulphuris*, a sulphureous Acid. Separate the one Liquor from the other, by the separating Funnel (*per Tritoreum*).

* I suppose he means, pour in half as much fresh *Alcohol*, as you did at first, that is, Two Pounds Weight, to the Liquor remaining in the Retort.

† N. B. The above-mentioned Liquors are to be purified from the strong-smelling Sulphur, and superfluous Acid, which is performed in the following manner:

Pour the Liquor, which swam at Top, into a Phial; drop into it Drop by Drop successively, a sufficient Quantity of Spirit of *Salt Armoniac*, prepared either from Salt Ammoniac with Quick-lime, or from Salt Ammoniac and Salt of Tartar, with common Water, and not with Spirit of Wine: Every Operator knows the Quantity; viz. continue dropping in of such Spirit upon the Liquor of the *Phlogiston*, till all Effervescence ceases, and all the acid Taste, with the sulphureous Smell, vanishes, being precipitated by the volatile *Alkali* to the Bottom.

3^{dly}, Let the whole Liquor be rectified in a fresh Retort by a most gentle Heat of a *Balneum Mariæ*, or of an Hand as hot as that of a Person in a Fever; and then keep it for Chemical Uses.

4^{thly},

The Doctor propos'd at some subsequent Meeting, to exhibit Four other simple *æthereal Spirits*, but of saline Origins, equally subtile with this *æthereal Spirit of Wine*.

Soon after this the Doctor died, and never discover'd any thing relating to these elementary *æthereal Liquors*; only in a Paper he left in my Hands, he gave these few Hints of their Nature.

There are Four Spheres opened, one of the Earth, one of the Sea, one of the Air, and one of the Heaven.

4thly, The inferior Liquor is to be purified as well as that which swam on the Top, but it must be done by Oil of Tartar *per Deliquium*, till all Ebullition intirely ceases: By evaporating all the Humidity of this Liquor, you will have a peculiar *Terra foliata Tartari*, which, being reduced into a *Calx*, shines in the Crucible like oriental Pearls, or a Peacock's Tail. This Earth has nothing of a pungent Taste, and is to be esteemed as a Sheet-anchor in the most ardent Fevers.

N. B. This Earth is of diverse Colours, but it is not the common vulgar *Terra foliata* of Tartar; for it does not flow in the Fire, nor has the same Taste as the common. The common is made by pouring distilled Vinegar upon fixed Salt of Tartar, till an intire Saturation is made. The Uses of this were formerly known, and I know not by what Fate (says the Doctor) it is coming into Use again now. I thought proper to mention the Difference of these Preparations, because I am able, from innumerable Experiments, to demonstrate a real Diversity in them. I shall seem to have dwelt too long upon one thing, but I hope I shall be the less blamed, since I design to shew, that there are several *æthereal Liquors* besides this above-described; for there are not only such (*Φλογιστικά*, or) combustible Fluids, but there are likewise saline Liquors, and also some quite insipid, being a Mixture of Combustibles differently graduated, and extracted by no other Heat unless their internal Fire. In a word, as many Spheres as there are of the Elements, so many *æthereal*, or (if you rather chuse to call them so) *aëreal Liquids*, viz. the *Æther* of the Earth, of the Water, of the Air, and of the Fire: Which, with the Leave of the ROYAL SOCIETY, I intend shortly to lay before them.

Whoſoever therefore knows how to extract the *Eſſences* out of Vitriol and Nitre, whoſe Centres are Salt, (and the Surface of the Earth is Salt),

1. Poſſeſſes the Salt of the Earth.

2. The Salt of the Sea is made from the Sphere of the Sea, and common Salt.

3. That of the Air is made of *Sal Armoniac* and Salts of Vegetables.

4. The Eſſence of Fire is made ſoon and eaſily from a concentrated Spirit of Wine, or of Vegetables. Thus the Four genuine Elements of Nature are obtained.

XXXII. *An Account of the Fire-ball ſeen in the Air, and of the Exploſion heard, on Dec. 11. 1741. by the Right Honourable the Lord BEAUCHAMP, near London.*

ON Friday the 11th of this Month, being on the Mount in *Kensington* Gardens, at a Quarter paſt 10 o'Clock, the Sun ſhining bright, in a ſerene Sky, I ſaw towards the South, a Ball of Fire, of about Eight Inches Diameter, and ſomewhat oval, which grew to the Size of about a Yard and an half Diameter. It ſeemed to deſcend from above, and at the Diſtance of about half a Mile from the Earth, took its Courſe to the Eaſt, and ſeemed to drop over *Weſtminſter*. In its Courſe it aſſumed a Tail of Fourſcore Yards in Length; and before it diſappeared, it divided into Two Heads. It left a Train of Smoke all the Way as it went; and from the Place where it ſeemed

to drop, there arose a Smoke which continued ascending for 20 Minutes (as another Gentleman and I observed by our Watches); and at length formed into a Cloud, which assumed different Colours.

XXXIII. *A Letter from John Fuller, Esq; jun. F. R. S. to Sir Hans Sloane, Bart. late President of the ROYAL SOCIETY, concerning the same Meteor, in Suffex.*

Honoured S I R,

YESTERDAY in the Afternoon, between Twelve and One o'Clock, all this Part of the Country was alarmed with a most terrible Clap of Thunder, as it is generally imagined. The Sound came from the North, where the Weather appeared very black and dark all the Morning. The Sound was double, as if Two very large Cannons had been discharged at the Distance of about a Second from one another: Most People thought, just at the first hearing, that it was the Discharge of Cannons, till by the rolling and echoing of the Sound afterwards, they were convinced it was not. Our Neighbours thought some Powder-mills had been blown up; and I look upon them to be no bad Judges in such kind of Blasts, having been more than once alarmed with them, by the Powder-mills in the Neighbourhood. I have it by Report, that a Countryman, at Work in the Fields about Seven Miles North of us, saw a Flash of Lightning before he heard the Noise, but I cannot answer for the Truth of it: It is very easy to imagine, that Fancy and Fear

in

in a poor Countryman upon such an uncommon Occasion, might conjure up the Idea of Lightning. If it was Thunder and Lightning, the Effects of it must be very terrible somewhere; for it gave the same Report, and shook all the Houses just in the same Manner, that were above 20 Miles distant from one another North and South; which I think is an Argument, that it was more general than Thunder can possibly be. I should be glad to know whether or no it was perceived in *London*. I am,

Honoured S I R,

Rosehill, Dec. 12. 1741. *Your most dutiful Grandson,*

J. Fuller.

XXXIV. *A Letter from the Reverend Mr. William Gostling, Minor Canon of the Cathedral Church of Canterbury, to Mr. Peter Collinson, F. R. S. concerning the same Meteor, in Kent.*

Dear S I R,

Canterbury, Sunday,

Dec. 13. 1741.

ON *Friday* last the 11th Instant, about One in the Afternoon, I found my House violently shaken for some Seconds of Time, as if several loaded Carriages had been driving against my Walls; and heard a Noise, which at first my Family took for Thunder, but of an uncommon Sound. For my own part, (as I thought Thunder which would shake

us

us at that rate, would have been much louder) I concluded it an Earthquake: And, going immediately to the Top of my House, found the Sky cloudy, but nothing like a Thunder-cloud in View; only there was a Shower of Rain from the Eastward presently after, and the coldest that I have felt. I thought the Shock an Earthquake, as I told you before; but since find it was attended (and I suppose caused) by a Ball of Fire, which passed with great Rapidity over our Country, from Westward to Eastward, for how long a Journey I cannot tell. It began with Two great Blows, like the Reports of Cannon, (which the Jumbling of my Sashes prevented my distinguishing); and then roll'd away till it was heard no more. The Appearance, I hear, was as that of a very large shooting Star; and it left a Train of Light, which soon disappeared, it being Noon day. If this was a general thing, your SOCIETY will hear of it from all Parts; if only with us, I suppose this Account will give you some Pleasure. It is the best I am yet able to send you: But I ought to tell you, I met a Pilot To day, coming from *Deal*, whom I asked about it; and he told me he saw no Fire-ball, but heard the Noise, and that it made the Ship shake he was in, going from *Gravesend* to the *Nore*.

Farewell.

W. Gostling.

See more Accounts of this Matter in the next Transaction.

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This *Hypocaust* may serve as a Model for *Mat-kilns*, or for drying *Hops*, &c.

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X

TO THE

Forty-first VOLUME

OF THE

Philosophical Transactions.

For the YEARS 1739, 1740, and 1741.

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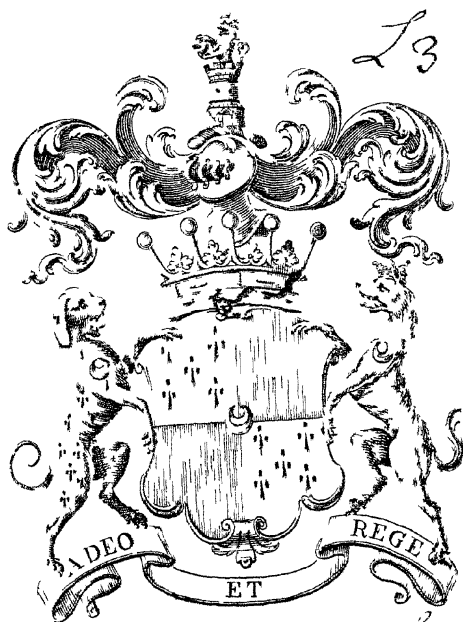
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Philip Carl Hanthoep